DEVELOPMENT OF IMPROVED METHODS FOR INTERNAL DOSIMETRY CALCULATIONS

By

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This dissertation presents improvements in three areas of nuclear medicine dosimetry: diagnostic, therapy, and the special case of bone dosimetry. For diagnostic nuclear medicine dosimetry, a new series of five pediatric head and brain dosimetric models are developed. They extend the new adult MIRD model to pediatric patients by including new source and target regions (eyes, eight brain subregions, a define neck). The EGS4 Monte Carlo transport code is used to tabulate absorbed fractions of energy for photon and electron sources within the pediatric model series. Subsequently, these absorbed fractions are used in the tabulations of radionuclide S values for use in pediatric neuroimaging studies.

In bone dosimetry, new three-dimensional transport models of electrons are developed for both trabecular and cortical bone. These new models are used with the

EGS4-PRESTA code to calculate absorbed fractions of energy, considering the trabecular marrow space, endosteum, and bone volume as source and target regions. A one-dimensional transport model is also developed to evaluate improvements using three-dimensional transport. These absorbed fractions are then used to calculate bone site-specific S values. Subsequently, skeletal-averaged S values based on the site-specific S values are derived. Differences seen with previously published bone S values are analyzed. The skeletal-averaged S values are then used to compare the dosimetric advantage of beta-emitting radionuclides in their use for the palliation of bone pain from bone metastases. As a result of this comparison, ^{33}P is found to have the best dosimetric characteristics for the alleviation of bone pain.

Finally, a new tool for the dosimetry of nonuniform activity distributions in nuclear medicine therapy is developed which is based on the MIRD methodology of dose calculation. Three-dimensional cumulated activity derived from SPECT images can be convoluted with S values calculated for the same voxel arrangement to generate average dose to voxels within the SPECT images. Voxel S values are calculated using the EGS4 Monte Carlo transport code for 21 voxel sizes ranging from 0.05 to 1.0 cm. A specific absorbed fraction interpolation schema is then derived for other voxel sizes. Examples of the clinical use of this dose calculation method are also provided.

CHAPTER 1
INTRODUCTION

It is possible to distinguish two principal areas in the field of nuclear medicine dosimetry. The first is associated with diagnostic nuclear medicine procedures. In these procedures, injected activities are usually low (in the μCi range), and no deterministic radiation effects are expected. Hence, dose calculations are primarily intended for radiation protection purposes and therefore focus on quantifying the average organ dose. The second distinct area in nuclear medicine dosimetry is associated with therapeutic nuclear medicine procedures. In these procedures, activities injected are generally high (in the mCi range). The objectives of injecting a radiopharmaceutical are to deliver a high and uniform dose to the tumor cells while minimizing the dose to healthy tissues. Consequently, more precise and localized dose estimates from nonuniform activity distribution are needed in order to maximize the therapeutic benefit of the treatment.

It is possible to distinguished a third area in nuclear medicine dosimetry: the dosimetry associated with the skeletal system. Indeed, bone has a highly heterogeneous structure with randomly interlacing soft and hard tissue regions. Additionally, bone is a very radiosensitive organ due to the low level of differentiation of certain populations of its cells and their high rate of cellular division. Furthermore, it is generally the dose limiting organ in both radioimmunotherapy and bone pain palliation treatments. Since bone dosimetry is applied in very complex geometry, with spatially distributed and dosimetrical important regions, it is an area of nuclear medicine dosimetry of its own. Table 1.1 summarizes the different areas of dosimetry performed in nuclear medicine.

The dose calculation methodology used in nuclear medicine dosimetry, has been developed by Loevinger and Berman in 1968 for the Society of Nuclear Medicine's Medical Internal Radiation Dose (MIRD) Committee (*1, 2*). In this methodology, the absorbed dose, defined as the amount of energy from ionizing radiation that is deposited per unit mass at the site of interest, is calculated by multiplying the cumulated activity within the source region, $\tilde{\mathrm{A}}(\text{source})$, by a S value from the source region to the target region, $\mathrm{S}(\text{target} \leftarrow \text{source})$:

$$\overline{\mathrm{D}}(\text{target} \leftarrow \text{source}) = \tilde{\mathrm{A}}(\text{source})\mathrm{S}(\text{target} \leftarrow \text{source}). \qquad \text{Eq. 1.1}$$

In this dose calculation schema, the cumulated activity $\tilde{\mathrm{A}}$ represents the total number of nuclear transitions within the source region. This quantity is generally calculated by first measuring the activity in the source region and then integrating it over the full time of irradiation, which in mathematical terms corresponds to infinity. Methods of measurements of the activity generally depend on the nuclear medicine dosimetric application. Planar imaging is generally used in diagnostic nuclear medicine dosimetry. In therapy nuclear medicine dosimetry, three-dimensional SPECT imaging over a region of interest is more commonly used. For bone dosimetry, sample blood count, bone biopsy, or three-dimensional SPECT imaging are normally used.

The second term of the MIRD formalism of dose calculation shown in Equation 1.1 is the S value. S values are defined for a given radionuclide and for a given source and target combination. They represent the amount of energy deposited in the target region from the source region per nuclear transition in the source, and per unit mass of target. In other words, the S value is the absorbed dose to a target region from a source region per unit cumulated activity in the source region. For a given radionuclide, and a given source-target combination, the S value is calculated by summing over all nuclear transitions the amount of energy deposited per unit target mass. This amount of energy is calculated by multiplying the mean energy emitted per nuclear transition Δ_i by the fraction of energy absorbed (ϕ) per unit target mass m_{Target} for the i^{th} transition:

$$S(\text{target} \leftarrow \text{source}) = \sum_{i}^{\substack{\text{All Nuclear}\\ \text{Transitions}}} \Delta_i \frac{\phi_i(\text{target} \leftarrow \text{source})}{m_{t\arg et}} . \qquad \text{Eq. 1.2}$$

All S values and absorbed fractions ϕ of interest in nuclear medicine dosimetry are generally tabulated *(3-5)*. In the case of dosimetry associated with whole body organs, due to their highly complex structure and inhomogeneities, the MIRD schema introduces the use of simplified three-dimensional mathematical models of the human body. However, this schema is not only valid for source and target regions as whole organs, but it can also be applied for all types of source and target regions *(6-8)*.

The research presented here involves the simulation of photon and electron transport within body tissues. For this purpose, the Monte Carlo transport code Electron Gamma Shower Version 4 (EGS4) is used *(9-11)*. This code has been extensively benchmarked for both electron and photon transport, and is widely accepted in the field of medical physics and internal dosimetry. It permits the treatment of multi-material media during both electron and photon transport, in a user-defined three-dimensional arbitrary geometry.

In the work performed for this dissertation, the three principal areas of internal nuclear medicine dosimetry are considered. In Chapter 2, new mathematical pediatric phantoms of the head and brain for use in diagnostic nuclear medicine are presented. A previous adult head and brain model was recently adopted by the MIRD Committee as the new standard model for adult head and brain nuclear medicine internal dosimetry, and these new pediatric models represent its logical extension to younger ages.

Chapters 3 through 6 concern the internal dosimetry of the skeletal system. Chapters 3 and 4 introduce new transport models of electron in trabecular and cortical bone, respectively. Chapter 5 presents the use of these models to tabulate S values for use in nuclear medicine bone dosimetry. Finally, Chapter 6 discusses a new method to compare radionuclides that are likely to be used for the palliation of bone pain from bone metastases. This methodology uses the S values tabulated in Chapter 5.

Chapter 7 involves therapy nuclear medicine dosimetry. Due to the nonuniformity distribution of the activity injected, point kernel dose type calculation and Monte Carlo transport code are generally used. A new method of dose calculation for nonuniform activity distribution using the MIRD methodology is presented and analyzed.

Three principal areas of nuclear medicine dosimetry are therefore covered in this dissertation. This work is also associated with several publications in scientific journals presented in Table 1.2. The last chapter of this dissertation presents general concluding remarks and future work.

Table 1.1: Summary of the three principal areas of dosimetry in nuclear medicine.

	Diagnostic Nuclear Medicine Dosimetry	**Therapy Nuclear Medicine Dosimetry**	**Bone Dosimetry in Nuclear Medicine**
Primarily purpose for the Dose Calculation	Radiation protection	Maximize the therapeutic ratio (dose to tumor vs. dose to healthy tissue)	Minimize marrow toxicity (myelotoxicity)
Type of Dose Calculation	Average organ dose	Dose distribution at tumor site	Dose to red marrow and endosteum
Range of Activity Injected	µCi	mCi	µCi to mCi
Method of Quantification for $\tilde{A}$	Planar imaging	3D SPECT imaging	Sample blood count, Bone biopsy, or 3D SPECT imaging
Method of Calculation of the S Value	Use of simplified 3D mathematical models of the human body	Use of Point Kernel, Monte Carlo, or Voxel S value methodology	Use of transport models of electron path through mixture of soft tissue and bone

Table 1.2: List of publications associated with the work presented in this dissertation.

Title of the Publication	Authorship	Type of Publication	Status[*]
Research on Head and Brain Dosimetry			
A Revised Dosimetric Model of the Adult Head and Brain	LG Bouchet, WE Bolch, DA Weber, HL Atkins, and JW Poston, Sr	Scientific Paper in JNM[†]	Published
MIRD Pamphlet No. 15: Radionuclide S Values in a Revised Dosimetric Model of the Adult Head and Brain	LG Bouchet, WE Bolch, DA Weber, HL Atkins, JW Poston, Sr	Scientific Paper in JNM[†]	In Press
Five Pediatric Head and Brain Mathematical Models for Use in Internal Dosimetry	LG Bouchet, WE Bolch	Scientific Paper in JNM[†]	Submitted
Brain and Head Dosimetry in Nuclear Medicine	LG Bouchet, WE Bolch	MIRD monograph	In Preparation
Research on the Use of Voxel S value in the Dosimetry of Nonuniform Activity Distribution			
MIRD Pamphlet No. 17: The Dosimetry of Nonuniform Activity Distribution - Radionuclide S Values at the Voxel Level	WE Bolch, LG Bouchet, JS Robertson , BW Wessels, JA Siegel, RW Howell, AK Erdi, B Aydogan, S Costes, and EE Watson	Scientific Paper in JNM[†]	In Press
Development of a Database of Voxel S values for the Dosimetry of Nonuniform Activity Distribution	LG Bouchet, WE Bolch	Scientific Paper in Med. Phys.[‡]	In Preparation
MIRD Voxel S values for Use in the Dosimetry of Nonuniform Activity Distribution	LG Bouchet, WE Bolch	MIRD monograph	In Preparation
Research on Skeletal Dosimetry			
A Three-Dimensional Transport Model for Determining Absorbed Fractions of Energy for Electrons Within Trabecular Bone	LG Bouchet, WJ Jokisch, WE Bolch	Scientific Paper in JNM[†]	Submitted
A Three-Dimensional Transport Model for Determining Absorbed Fractions of Energy for Electrons Within Cortical Bone	LG Bouchet, WE Bolch	Scientific Paper in JNM[†]	Submitted
New Regional Trabecular and Cortical Bone S Values for Use in Skeletal Dosimetry	LG Bouchet, WE Bolch, RW Howell, and DV Rao	Scientific Paper in JNM[†]	Submitted
Selection of Radionuclides for Palliation of Bone Pain from Metastatic Osseous Lesion	LG Bouchet, WE Bolch, SM Goddu, RW Howell, and DV Rao	Scientific Paper in JNM[†]	Submitted

[*] Status as October 1998

[†] Journal of Nuclear Medicine

[‡] Medical Physics Journal

CHAPTER 2
PEDIATRIC HEAD AND BRAIN MODELS

The Need for Pediatric Brain Dosimetry

Over the past decade, the nuclear medicine profession has seen a marked increased in the use of radiopharmaceuticals for neuroimaging (*12-16*). The relatively high target specificity of some of these agents, and the improvements in spatial resolution of new single photon emission computed tomography (SPECT) and positron emission tomography (PET) imaging systems, presently allow the direct quantification of activity within intrabrain regions (*14*). In estimating the radiation absorbed dose from these agents, conventional models of the head and brain typically allow for the calculation of only an average brain dose (*17-20*). To improve head and brain dosimetry, the MIRD Committee recently adopted a new adult model of the head and brain (*3, 21, 22*). This new model considers eight brain subregions (caudate nuclei, cerebellum, cerebral cortex, lateral and third ventricles, lentiform nuclei, thalami, and white matter) and 11 regions within the head (cranium, cranial cerebrospinal fluid (CSF), eyes, mandible, skin, spinal chord, spinal CSF, spinal skeleton, teeth, thyroid, and an upper facial region). The improvements to brain and head dosimetry were illustrated in MIRD Pamphlet No. 15 (*3*) by a dose calculation using ^{123}I-IPT, a tropane analog of cocaine that concentrates nonuniformily within the brain (*23*). It was shown that for this radiopharmaceutical, the absorbed dose to the caudate nuclei and lentiform nuclei was approximately 5 times the absorbed dose averaged across the total brain, the only dosimetry estimate available from older brain models. The need for improvements in brain dosimetry extends to these studies involving pediatric patients. Existing models which consider the brain as a single elliptical region limit the accuracy and extent of dose calculations.

Pediatric patients are generally more at risk from radiation than adults in that: (1) their growing tissues are more susceptible to radiation effects than mature adult tissues (*24*); (2) their skeleton encompasses a greater fractional distribution of active marrow (*25*); and (3) the greater post-exposure life expectancy of infants and children increases the possibility for any radiation-induced effects to manifest. In pediatric nuclear medicine dosimetry, five anthropomorphic models developed by Cristy and Eckerman are generally used: a newborn, 1-year-old, 5-year-old, 10-year-old, and a 15-year-old (*17, 18*). These models incorporate very simplistic head and brain region geometries: brain subregions are not outlined, the eyes are not modeled, and a distinct neck region is not defined within the head. New pediatric dosimetric models of the head and brain based on the new MIRD adult head and brain model would therefore offer benefits in estimating absorbed dose for pediatric patients undergoing nuclear medicine procedures.

Pediatric Nuclear Medicine Involving the Head and Brain

Pediatric nuclear medicine applications that will benefit from new dosimetric head and brain models include brain imaging (*26*), thyroid imaging and therapy (*27*), and cerebrospinal fluid physiology imaging (*28*).

Brain nuclear medicine procedures include perfusion SPECT, assessment of the metabolic activity of tumors, and specific receptor imaging (*26*). In perfusion brain

SPECT, radiopharmaceuticals used include ^{99m}Tc hexamethyl-propyleneamine oxim (HMPAO), ^{99m}Tc bicistate, ^{99m}Tc 1,1-ethyl cysteinate dimer (ECD), ^{123}I N-a-methylethyl-p-iodoamphetamine (IMP), and ^{133}Xe. A unique technical advantage over all other diagnostic methodologies for perfusion imaging is that the tracer is trapped intracellularly such that it remains fixed in the brain for several hours after the intravenous administration. Therefore, at the time of injection, the child does not need to be near the camera. This is very advantageous for capturing changes in regional cerebral blood flow (rCBF) during unpredictable events such as seizures. It is generally used to assist in localizing epileptogenic foci in children presenting with medically refractory seizures who are candidates for resective surgery. Other applications of pediatric nuclear medicine rCBF imaging include diagnosis of seizure subtypes, evaluation of pre- and posthemispherectomy patients, alternating hemiplegia, developmental and neuropsychiatric disorders, and cerebrovascular disease of childhood.

Detection of active brain tumors is another nuclear medicine brain procedure that can be performed on children. Due to their accumulation in active tumor tissue within a few minutes after intravenous injection, ^{201}Tl-chloride, ^{18}F-fluorodeoxyglucose (FDG), and ^{99m}Tc-methoxy isobutyl isonitrile (MIBI) are commonly used, and typically serve as an indicator of residual tumor after treatment.

Imaging of specific brain receptors can also be performed on children. Mapping of brain receptors has been performed with PET, and can also be accomplished with SPECT. Although many of the developments in receptor imaging have applied to adult disorders, several conditions of childhood may have an important component of receptor dependency.

Thyroid nuclear medicine procedures or scintigraphy may be used for diagnostic evaluation of the pediatric thyroid gland (*27*). Iodine-123 is generally the radiopharmaceutical of choice, but ^{99m}Tc-sodium pertechnetate is also used due to its widespread availability. Iodine-131 has also been used to image the thyroid, but due to the high beta dose radiation, it is not recommended for routine diagnostic examinations. However, ^{131}I therapy is generally the standard treatment for hyperthyroidism in children. Thallium-201 and ^{99m}Tc-MIBI have been also used to localize thyroid carcinoma.

Another diagnostic tool used on children is radionuclide cisternography (*28*). This procedure consists in assessing the physiology of the CSF pathway by using a tracer directly injected in the CSF space. Indium-111 diethylenetriamine-pentaacetic acid (DTPA) and ^{99m}Tc-DTPA are generally used with a preference for ^{99m}Tc due to its high photon flux and lower radiation dose. The most common clinical applications of this technique are diagnosis of hydrocephalus, loculations of CSF, porencephalic cyst, and block of spinal CSF flow by tumors or other lesions.

Previous Pediatric Dosimetric Model of the Head and Brain

In 1966, Fisher and Snyder developed the first mathematical model of the adult for use in radiation absorbed dose calculations (*29*). The model consisted of three sections: the head, trunk, and legs. This early model was homogeneous in composition, and thus no attempt was made to model either the lungs or the skeleton as separate media. In parallel, five other phantoms representing children of ages 0, 1, 5, 10, and 15-years were developed. These models were modeled with outer dimensions representing the average height, surface area, and body mass of a child of the particular age. They were obtained by using similitude transformations to the adult model. Their primary intent was not for use in pediatric nuclear medicine, but for comparisons of the dose distribution from a uniform distribution of ^{137}Cs in adult and in the smaller models. In 1967, Fisher and Snyder reported on the development of an adult model with 22 internal organs (*30*). This model is an important landmark because it represents a step in the development of anthropomorphic models. However, this model remained homogeneous in composition, and no differentiation between lung and bone tissues was made.

The first heterogeneous standardized adult model for use in internal dose assessment appeared in 1969 with the publication of MIRD Pamphlet No. 5 (MIRD 5) (*19*). The head and neck regions were represented as a truncated elliptical cylinder enclosing the skull, the brain, the spine, and the thyroid, and the brain was modeled as a single ellipsoid of soft tissue (Figure 2.1-A). This model was used in conjunction with a Monte Carlo photon transport code to estimate absorbed fractions of energies for internal photon sources. To estimate the dose in children, Snyder and co-workers used the similitude method to scale down the adult model (*31-35*). Three scaling factors were used for each of the three orthogonal coordinate axes. The dimensions were chosen to represent a newborn, 1-year-old, 5-year-old, 10-year-old, and 15-year-old (the fifteen-year-old also represented the adult female). The derived models were called the similitude phantoms. For the shape and positions of the different body organs, the similitude rule is a good first approximation. However, children are not simply small adults and their organs are not necessarily smaller adult organs. These models were never adopted by the MIRD Committee, and were only published as a series of Oak Ridge National Laboratory reports.

In 1976, Hwang and co-workers developed a new series of pediatric models representing ages 0, 1, 5, and 15-years-old (*36-38*). These models were based on the adult model of Snyder in MIRD 5 (*19*) using the same equations for the body sections and organs. These equation parameters were claimed to have been developed independently, without using the similitude rule, but using anatomical references for pediatric organ size, shape, and position. However, a careful analysis of the model descriptions revealed that some organs in the pediatric models were still scaled versions of the adult model organs (*17*). As a result, positioning problems were present in these pediatric models, particularly in the lower part of the trunk where the organs had to be shifted around and crowded together to accommodate a larger lung size.

In 1978, a revision to MIRD 5, MIRD Pamphlet No. 5, Revised (MIRD 5R) (*20*), incorporated substantial changes to the anthropomorphic adult model. These changes improved the dosimetric information (e.g., inclusion of walls within the GI tract) and provided a better match to the information published in the ICRP Publication 23 on Reference Man (*39*). Few changes were made to the head region. The head shape was changed slightly and topped by one half of an ellipsoid (Figure 2.1-B). The pediatric series remained unchanged.

In 1980, Cristy developed six mathematical models representing humans of various ages (newborn, one-year-old, five-year-old, ten-year-old, fifteen-year-old, and an adult male) (*17*). In this series, the adult male was constructed as a modification to the MIRD 5R model (*20*). For the head region, the largest change was made to the skull in which it was redesigned to include a separate cranium and facial skeleton region (Figure 2.1-C). In designing the pediatric models, the similitude rule was used to obtain the organ shape and location, but the organ mass and volumes were obtained using data published and referenced in ICRP Publication 23 on Reference Man (*39*). In 1987, calculations of photon specific absorbed fractions were published by Cristy and Eckerman for this series of pediatric models and for internal photon sources assumed to be distributed uniformly within the source organs (*18*).

A separate study was performed by Eckerman et al. in 1980 in which differentiation between the white and gray matter was made in the Cristy adult brain model (*40*). A gray matter region was added, defined as an ellipsoidal shell with a slab dividing the brain into two hemispheres. The eyes were also represented in this model by two spheres (Figure 2.1-D). These changes were not incorporated in the pediatric models.

In 1995, an adult head and brain model was developed by Bouchet et al. (*21, 22*) to be used in brain imaging nuclear medicine dosimetry. This model defines a precise brain region including eight brain subregions: the caudate nuclei, cerebellum, cerebral cortex, lateral and third ventricles, lentiform nuclei, thalami, and white matter. It also includes eyes, precise facial and spinal regions, and distinct neck region. This model can be seen in a three-dimensional representation in Figure 2.2. It was adopted by the MIRD Committee to be used as the standard for brain and head dosimetry in diagnostic nuclear medicine (*3*). The MIRD Committee has also recently adopted this model to replace the Cristy and Eckerman head on top of the trunk for general internal dosimetry calculations. The Cristy and Eckerman series consists of six models, five of which are pediatric models. Since the newly adopted MIRD brain and head model was developed for only the average adult, it is also important for uniformity to develop pediatric models that are concordant with the adult model.

Mathematical Description of the Pediatric Head and Brain Models

The pediatric head and brain models are developed based on the new MIRD adult head and brain model (*3*). Therefore, they have the same regions, with each region having the same geometrical shape. The mathematical models are assumed to be erect and oriented in a Cartesian coordinate system. The origin is taken as the center of the base of the trunk, the positive x-axis is directed to the model's left, the positive y-axis toward the model's back, and the positive-z axis upwards toward the model's head. The equations for each head and brain region are given below in their general form. All the variables are described in Table 2.1 and listed for each age in Table 2.2. The volumes of the head and brain regions of all regions are given in Table 2.3 also for all ages. All the six models of the head and brain can be seen in a three-dimensional representation in Figure 2.3.

Description of the Shape of the Head

The head region is divided into four regions: the neck, the top of the head, the face, and the back of the head. These four regions are separated by two horizontal planes ($z = z_{H1}$ and $z = z_{H2}$) and one vertical plane normal to the y-axis ($y = y_H$). The face and the back of the head are located between the two horizontal planes and are separated by the vertical plane. The neck is located below the lower horizontal plane, and the top of the skull is located above the upper horizontal plane. The equations defining the shape of the head are given below.

The face is a vertical elliptical cylinder cut by three planes:

$$\left(\frac{x}{a_H}\right)^2+\left(\frac{y}{b_H}\right)^2\leq 1\text{, with } z_{H1}\leq z\leq z_{H2} \text{ and } y\leq y_H. \qquad \text{Eq. 2.1}$$

The top of the head is represented by half an ellipsoid:

$$\left(\frac{x}{a_H}\right)^2+\left(\frac{y}{b_H}\right)^2+\left(\frac{z-z_{H2}}{c_H}\right)^2\leq 1\text{, with } z\geq z_{H2}. \qquad \text{Eq. 2.2}$$

The neck is represented by a circular cylinder cut by two planes:

$$x^2+(y-y_N)^2\leq {R_N}^2\text{, with } C_T\leq z\leq z_{H1}. \qquad \text{Eq. 2.3}$$

The back of the head is an elliptical cone cut by three planes. The center y_1 of the elliptical sections and the two semi-axes a_1 and b_1 vary along the z-axis so that the upper and lower limits coincide, respectively, with the ellipse of the top of the cranium and with the circular outline of the neck. Consequently, the expressions for a_1, b_1, and y_1 are given as:

$$\left(\frac{x}{a_1}\right)^2+\left(\frac{y-y_1}{b_1}\right)^2\leq 1, \qquad \text{Eq. 2.4}$$

$$z_{H1}\leq z\leq z_{H2}\text{, and } y\geq y_H\text{, where} \qquad \text{Eq. 2.5}$$

$$a_1=\frac{a_H-R_N}{z_{H2}-z_{H1}}(z-z_{H1})+R_N, \qquad \text{Eq. 2.6}$$

$$b_1=\frac{b_H-R_N}{z_{H2}-z_{H1}}(z-z_{H1})+R_N\text{, and} \qquad \text{Eq. 2.7}$$

$$y_1=\frac{y_N}{z_{H2}-z_{H1}}(z_{H2}-z). \qquad \text{Eq. 2.8}$$

The external dimensions of the head were calculated by keeping the length of the head the same as the ORNL pediatric models (*17, 18*), and from breadth and length values given in reference *41*. The neck radius was derived from circumference values given in Reference *42*, and the neck length from the thyroid dimensions. The center axis of the neck was determined by keeping constant its relative position compared to the axis of the cylinder of the head.

Within the head and neck, 21 subregions are located. Five of these are skeletal regions (cranium, mandible, spinal skeleton, teeth, and upper face region), while the remaining regions are composed of soft tissue. Table 2.4 gives the atomic composition of both tissue types taken from Reference *18*. A different elemental composition is used for the newborn skeleton due to its lower specific density, and due to its higher water content and lower bone mineral content. The skeletal region represents a homogenized mixture of both bone matrix and bone marrow.

Description of the Skin of the Head

The skin is defined as a layer of soft tissue with thickness S surrounding the entire head and neck excluding the surface connecting the neck to the trunk. The skin thickness was obtained from Reference *43*, and is the same as in the ORNL pediatric models (*17, 18*). The following equations define the outer and inner layers of the skin regions:

The skin of the face:

$$\left(\frac{x}{a_H+S}\right)^2+\left(\frac{y}{b_H+S}\right)^2\leq 1,\ \text{and}\ y\leq y_H+S\ \text{for}\ z_{H1}-S\leq z\leq z_{H2}. \qquad \text{Eq. 2.9}$$

$$\left(\frac{x}{a_H}\right)^2+\left(\frac{y}{b_H}\right)^2\geq 1,\ \text{for}\ z_{H1}\leq z\leq z_{H2}. \qquad \text{Eq. 2.10}$$

$$x^2 + (y - y_N)^2 \geq R_N{}^2, \text{ for } z_{H1} - S \leq z \leq z_{H2}. \qquad \text{Eq. 2.11}$$

The skin of the top of the head:

$$\left(\frac{x}{a_H + S}\right)^2 + \left(\frac{y}{b_H + S}\right)^2 + \left(\frac{z - z_{H2}}{c_H + S}\right)^2 \leq 1, \qquad \text{Eq. 2.12}$$

$$\left(\frac{x}{a_H}\right)^2 + \left(\frac{y}{b_H}\right)^2 + \left(\frac{z - z_{H2}}{c_H}\right)^2 \geq 1, \text{ and } z \geq z_{H2}. \qquad \text{Eq. 2.13}$$

The skin of the neck:

$$x^2 + (y - y_N)^2 \leq (R_N + S)^2, \qquad \text{Eq. 2.14}$$

$$x^2 + (y - y_N)^2 \geq R_N{}^2, \text{ and } C_T \leq z \leq z_{H1} - S. \qquad \text{Eq. 2.15}$$

The skin of the back of the head:

$$\left(\frac{x}{a_1 + S}\right)^2 + \left(\frac{y - y_1}{b_1 + S}\right)^2 \leq 1, \qquad \text{Eq. 2.16}$$

$$\left(\frac{x}{a_1}\right)^2 + \left(\frac{y - y_1}{b_1}\right)^2 \geq 1, \qquad \text{Eq. 2.17}$$

$$z_{H1} - S \leq z \leq z_{H2}, \text{ and } y \geq y_H + S, \qquad \text{Eq. 2.18}$$

where a_1, b_1, and y_1 are defined by Equations 6 to 8. In two instances, however, the effective skin thickness becomes less than S due to region overlap with the eyes and the bottom ellipsoid of the cranium (described below).

Description of the Skeletal Regions

The Cranium: The cranium is taken as the volume between two pairs of concentric ellipsoids with the bottom pair cut by two inclined planes. It was derived in parallel with the cranial CSF (defined later) from the inner dimensions of the head, the outer dimensions of the brain and by keeping the thickness ratios between the cranial CSF and the cranium constant for all ages. The equations representing the cranium are:

For the inner surface:

$$\left(\frac{x}{a_{CR}}\right)^2+\left(\frac{y}{b_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR1}}\right)^2\geq 1 \text{ and } z\geq z_{H2}, \qquad \text{Eq. 2.19}$$

$$\left(\frac{x}{a_{CR}}\right)^2+\left(\frac{y}{b_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR2}}\right)^2\geq 1 \text{ and } z\leq z_{H2}, \qquad \text{Eq. 2.20}$$

$$z\geq z_{H2}-c_{CR2}\left(1+\frac{y}{b_{CR}}\right). \qquad \text{Eq. 2.21}$$

For the outer surface:

$$\left(\frac{x}{a_{CR}+t_{CR}}\right)^2+\left(\frac{y}{b_{CR}+t_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR1}+t_{CR}}\right)^2\leq 1 \text{ and } z\geq z_{H2}, \qquad \text{Eq. 2.22}$$

$$\left(\frac{x}{a_{CR}+t_{CR}}\right)^2+\left(\frac{y}{b_{CR}+t_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR2}+t_{CR}}\right)^2\leq 1 \text{ and } z\leq z_{H2}, \qquad \text{Eq. 2.23}$$

$$z\geq z_{H2}-\left(c_{CR2}+t_{CR}\right)\left(1+\frac{y}{b_{CR}+t_{CR}}\right). \qquad \text{Eq. 2.24}$$

The cranium is shown in the upper left-hand corner of Figure 2.4. Interior to the cranium is the subarachnoid space containing the cerebrospinal fluid (CSF) and the brain itself with its subregions.

Mandible: The mandible is modeled as the volume between three elliptical cylinders, two with the same center, and one with a different center. These cylinders are cut by three planes: one inclined plane, one horizontal plane, and one vertical plane. The top inclined plane corresponds to the cutting plane of the cranium, and the vertical plane corresponds to the vertical plane of the teeth and the upper face region. The mandible is shown in the bottom center of Figure 2.4. It is defined by the following equations:

For the front region:

$$\left(\frac{x}{a_{MA1}}\right)^2 + \left(\frac{y - y_{MA}}{b_{MA1}}\right)^2 \leq 1, \qquad \text{Eq. 2.25}$$

$$\left(\frac{x}{a_{MA2}}\right)^2 + \left(\frac{y - y_{MA}}{b_{MA2}}\right)^2 \geq 1, \qquad \text{Eq. 2.26}$$

$z_{MA1} \leq z \leq z_{MA2}$, and $y \leq y_{MA}$. Eq. 2.27

For the back region:

$$\left(\frac{x}{a_{MA1}}\right)^2 + \left(\frac{y - y_{MA}}{b_{MA1}}\right)^2 \leq 1, \qquad \text{Eq. 2.28}$$

$$\left(\frac{x}{a_{MA3}}\right)^2 + \left(\frac{y - y_{MA}}{b_{MA3}}\right)^2 \geq 1, \qquad \text{Eq. 2.29}$$

$z_{MA1} \leq z \leq z_{H2} - (c_{CR2} + t_{CR})\left(1 + \frac{y}{b_{CR} + t_{CR}}\right)$, and Eq. 2.30

$y_{MA} \leq y \leq 0$. Eq. 2.31

The Teeth: This region is represented by the volume between two concentric elliptical cylinders cut by three planes: two horizontal planes which define the boundaries of the upper face and the front part of the mandible, and one vertical plane which defines the back portion of the mandible. This region is shown in the lower left corner of Figure 2.4. The equations for this region are:

$$\left(\frac{x}{a_{TE1}}\right)^2 + \left(\frac{y - y_{MA}}{b_{TE1}}\right)^2 \leq 1, \qquad \text{Eq. 2.32}$$

$$\left(\frac{x}{a_{TE2}}\right)^2+\left(\frac{y-y_{MA}}{b_{TE2}}\right)^2\geq 1, \qquad \text{Eq. 2.33}$$

$$z_{MA2}\leq z\leq z_{TE} \text{ and } y\leq y_{MA}. \qquad \text{Eq. 2.34}$$

The Upper Face Region: The upper face region (approximating the maxilla and zygomatic bone) is defined as an elliptical cylinder cut by an inclined plane that coincides with the cutting plane of the cranium. It is bounded by the mandible on the back, and below by the upper plane of the teeth. The upper face region, along with the eyes, is shown in the middle left side of Figure 2.4. The upper face region is defined by the following equations:

$$\left(\frac{x}{a_{UF}}\right)^2+\left(\frac{y}{b_{UF}}\right)^2\leq 1, \qquad \text{Eq. 2.35}$$

$$z_{TE}\leq z\leq z_{H2}-\left(c_{CR2}+t_{CR}\right)\left(1+\frac{y}{b_{CR}+t_{CR}}\right), \text{ and } y\leq y_{MA}. \qquad \text{Eq. 2.36}$$

$$\left(x\pm x_{EY}\right)^2+\left(y-y_{EY}\right)^2+\left(z-z_{EY}\right)^2\geq R_{EY}{}^2 \qquad \text{Eq. 2.37}$$

Note, that the volume representing the eyes is also excluded from the upper face region as shown in the equations above.

The three regions defined above formed the regions of the face. They were derived in parallel in three steps. First, the height of each region was derived using dimensions published in Reference *41*. Then, the x and y dimensions of those regions were determined assuming their growth rate to be the same as the cranium. Finally, translations were applied to avoid overlapping with other head regions.

Description of the Regions of the Spine

The spine is represented by an elliptical cylinder bounded by the cranium. Two concentric elliptical cylinders further define the spinal cord and the spinal CSF, both assumed to be composed of soft tissue. The spinal skeleton itself is a region of skeletal tissue as defined in Table 2.4.

The equations for the spinal skeleton are:

$$\left(\frac{x}{a_{SP}}\right)^2+\left(\frac{y-y_{SP}}{b_{SP}}\right)^2\leq 1, \qquad \text{Eq. 2.38}$$

$$\left(\frac{x}{R_{SP1}}\right)^2+\left(\frac{y-y_{SP}}{R_{SP1}}\right)^2\geq 1, \qquad \text{Eq. 2.39}$$

$$\left(\frac{x}{a_{CR}+t_{CR}}\right)^2+\left(\frac{y}{b_{CR}+t_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR2}+t_{CR}}\right)^2\geq 1, \text{ and } z\geq C_T. \qquad \text{Eq. 2.40}$$

The equations for the spinal CSF are:

$$\left(\frac{x}{R_{SP1}}\right)^2+\left(\frac{y-y_{SP}}{R_{SP1}}\right)^2\leq 1, \qquad \text{Eq. 2.41}$$

$$\left(\frac{x}{R_{SP2}}\right)^2+\left(\frac{y-y_{SP}}{R_{SP2}}\right)^2\geq 1, \qquad \text{Eq. 2.42}$$

$$\left(\frac{x}{a_{CR}+t_{CR}}\right)^2+\left(\frac{y}{b_{CR}+t_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR2}+t_{CR}}\right)^2\geq 1, \text{ and } z\geq C_T. \qquad \text{Eq. 2.43}$$

The equations for the spinal cord are:

$$\left(\frac{x}{R_{SP2}}\right)^2+\left(\frac{y-y_{SP}}{R_{SP2}}\right)^2\leq 1, \qquad \text{Eq. 2.44}$$

$$\left(\frac{x}{a_{CR}+t_{CR}}\right)^2+\left(\frac{y}{b_{CR}+t_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR2}+t_{CR}}\right)^2\geq 1\text{, and } z\geq C_T. \qquad \text{Eq. 2.45}$$

These regions are shown in the middle right portion of Figure 2.4 with the spinal skeleton shown in magenta, the spinal CSF in green, and the spinal cord in pink. The volume of the spinal region was derived assuming the same growth pattern as the brain (*42*). Then, its relative position within the neck was assumed to remain constant with age.

Description of the Soft Tissue Regions (Excluding Brain)

The Cerebral Spinal Fluid (CSF) within the Cranial Region: This region is a thin layer located between the cranium and the brain, in the subarachnoid space. It has the same shape as the cranium. The equations that define this region are:

For the inner surface:

$$\left(\frac{x}{a_{CR}-t_{CSF}}\right)^2+\left(\frac{y}{b_{CR}-t_{CSF}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR1}-t_{CSF}}\right)^2\geq 1 \text{ and } z\geq z_{H2}, \qquad \text{Eq. 2.46}$$

$$\left(\frac{x}{a_{CR}-t_{CSF}}\right)^2+\left(\frac{y}{b_{CR}-t_{CSF}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR2}-t_{CSF}}\right)^2\geq 1 \text{ and } z\leq z_{H2}, \qquad \text{Eq. 2.47}$$

$$z\geq z_{H2}-\left(c_{CR2}-t_{CSF}\right)\left(1+\frac{y}{b_{CR}-t_{CSF}}\right). \qquad \text{Eq. 2.48}$$

For the outer surface:

$$\left(\frac{x}{a_{CR}}\right)^2+\left(\frac{y}{b_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR1}}\right)^2\leq 1 \text{ and } z\geq z_{H2}, \qquad \text{Eq. 2.49}$$

$$\left(\frac{x}{a_{CR}}\right)^2+\left(\frac{y}{b_{CR}}\right)^2+\left(\frac{z-z_{H2}}{c_{CR2}}\right)^2\leq 1 \text{ and } z\leq z_{H2}, \qquad \text{Eq. 2.50}$$

$$z \geq z_{H2} - c_{CR2}\left(1 + \frac{y}{b_{CR}}\right). \qquad \text{Eq. 2.51}$$

The Eyes: Both eyes are modeled as spheres. They are located in the upper face region, and overlap part of the skin. They were derived from the volumes given in ICRP 23 (*39*), from measurements on MRI images (*44*), and using their relative position compared within the upper face region. The equations for the eyes are:

$$(x \pm x_{EY})^2 + (y - y_{EY})^2 + (z - z_{EY})^2 \leq R_{EY}{}^2 \qquad \text{Eq. 2.52}$$

The Thyroid: The thyroid used in these models is the same used in the ORNL pediatric models (*17, 18*). It is located in the neck, in front of the spinal region, and is composed of two lobes. These two lobes are represented as the volumes between two concentric cylinders cut by a fourth degree surface, two horizontal planes, and one vertical plane. The fourth degree surface is symmetrical between the left and the right lobes, and is different between the upper part and the lower part. Hence, the thyroid is divided into four regions that are limited by a horizontal plane ($y = y_{THY}$ and the plane $x = 0.00$). This organ is shown in the lower right corner of Figure 2.4. The equations defining the thyroid are:

For the upper part:

$$x^2 + (y - y_{THY})^2 \leq (R_{THY1})^2, \qquad \text{Eq. 2.53}$$

$$x^2 + (y - y_{THY})^2 \geq (R_{THY2})^2, \qquad \text{Eq. 2.54}$$

$$((y - y_{THY}) - |x|)^2 \geq 2\left(x^2 + (y - y_{THY})^2\right)^2, \qquad \text{Eq. 2.55}$$

$$C_T + \frac{1}{4}((z_{H1} - S) - C_T) \leq z \leq z_{H1} - S \text{ and } y \leq y_{THY}\text{, and} \qquad \text{Eq. 2.56}$$

$$\tau = \frac{2-\sqrt{2}}{\frac{3}{2}\left(\left(z_{H1}-S\right)-C_T\right)}\left(z-C_T\right)+\frac{2\sqrt{2}-1}{3}. \qquad \text{Eq. 2.57}$$

For the lower part:

$$x^2+\left(y-y_{THY}\right)^2 \leq \left(R_{THY1}\right)^2, \qquad \text{Eq. 2.58}$$

$$x^2+\left(y-y_{THY}\right)^2 \geq \left(R_{THY2}\right)^2, \qquad \text{Eq. 2.59}$$

$$\left(\left(y-y_{THY}\right)-|x|\right)^2 \geq 2\left(x^2+\left(y-y_{THY}\right)^2\right)^{\ 2}, \qquad \text{Eq. 2.60}$$

$$C_T \leq z \leq C_T+\frac{1}{4}\left(\left(z_{H1}-S\right)-C_T\right) \text{ and } y \leq y_{THY}\text{, and} \qquad \text{Eq. 2.61}$$

$$\tau = \frac{\sqrt{2}-2}{\frac{1}{2}\left(\left(z_{H1}-S\right)-C_T\right)}\left(z-C_T\right)+1. \qquad \text{Eq. 2.62}$$

Description of the Brain and its Subregions

The brain is located inside the cranium as described earlier, and is surrounded by the CSF within the subarachnoid space. It is formed by 8 regions: the caudate nuclei, the cerebellum, the cerebral cortex, the lateral ventricles, the lentiform nuclei, the thalami, the third ventricle, and the white matter. Its total volume follow the value given in ICRP Publication 23 (*39*).

The cerebral cortex: The cerebral cortex is defined by two half ellipsoids. The bottom ellipsoid is cut by both an inclined plane and by a vertical plane. The top ellipsoid is not cut. The region has a constant thickness of t_{CC} all around, and at its center it extends inside the brain in a parallelepiped of thickness twice t_{CC} (representing the cortex bordering the longitudinal cerebral fissure). A wedged cut is made on the back portion of the lower ellipsoid for location of the cerebellum. A t_{CC} thickness also covers the two interior plane regions of the cerebellum. The thickness of the cerebral cortex was derived using reference *45*. The equations defining the cerebral cortex are given below.

For the outer surface:

$$\left(\frac{x}{a_{BR}}\right)^2+\left(\frac{y}{b_{BR}}\right)^2+\left(\frac{z-z_{H2}}{c_{BR1}}\right)^2\leq 1 \text{ and } z\geq z_{H2}, \qquad \text{Eq. 2.63}$$

$$\left(\frac{x}{a_{BR}}\right)^2+\left(\frac{y}{b_{BR}}\right)^2+\left(\frac{z-z_{H2}}{c_{BR2}}\right)^2\leq 1 \text{ and } z\leq z_{H2}, \qquad \text{Eq. 2.64}$$

$$y\leq y_{BR} \text{ when } z\leq z_{H2}, \text{ and} \qquad \text{Eq. 2.65}$$

$$z\geq z_{H2}-c_{BR2}\left(1+\frac{y}{b_{BR}}\right). \qquad \text{Eq. 2.66}$$

For the inner surface:

When $z\geq z_{H2}+t_{cc}$:

$$\left(\frac{x}{a_{BR}-t_{CC}}\right)^2+\left(\frac{y}{b_{BR}-t_{CC}}\right)^2+\left(\frac{z-z_{H2}}{c_{BR1}-t_{CC}}\right)^2\geq 1 \text{ if } |x|\geq t_{CC}. \qquad \text{Eq. 2.67}$$

When $z_{H2}\leq z\leq z_{H2}+t_{cc}$:

$$\left(\frac{x}{a_{BR}-t_{CC}}\right)^2+\left(\frac{y}{b_{BR}-t_{CC}}\right)^2+\left(\frac{z-z_{H2}}{c_{BR1}-t_{CC}}\right)^2\geq 1 \text{ and } y\leq y_{BR}-t_{CC}. \qquad \text{Eq. 2.68}$$

When $z\leq z_{H2}$:

$$\left(\frac{x}{a_{BR}-t_{CC}}\right)^2+\left(\frac{y}{b_{BR}-t_{CC}}\right)^2+\left(\frac{z-z_{H2}}{c_{BR2}-t_{CC}}\right)^2\geq 1, \qquad \text{Eq. 2.69}$$

$$y\leq y_{BR}-t_{CC}, \text{ and } z\geq z_{H2}-\left(c_{BR2}-t_{CC}\right)\left(1+\frac{y}{b_{BR}-t_{CC}}\right). \qquad \text{Eq. 2.70}$$

The cerebellum: The cerebellum is located on the back of the brain. It is defined by an ellipsoid cut by one vertical plane and one horizontal plane. The two planes correspond to the layers of cerebral cortex covering the cerebellum. Its volume was chosen using reference *46*. This region is defined by the following equations:

$$\left(\frac{x}{a_{BR}}\right)^2+\left(\frac{y}{b_{BR}}\right)^2+\left(\frac{z-z_{H2}}{c_{BR2}}\right)^2\leq 1, \qquad \text{Eq. 2.71}$$

$$z\leq z_{H2}, \text{ and } y\geq y_{BR}. \qquad \text{Eq. 2.72}$$

Figure 2.2-B shows the cerebral cortex and the cerebellum, along with other brain structures defined below. In order to view the cerebellum, a coronal slice through the cerebral cortex is made, and the layer of cerebral cortex covering the cerebellum has been removed.

The thalami: The thalami are represented by two ellipsoids, one in the right hemisphere and one in the left hemisphere. Their defining equation is:

$$\left(\frac{x\pm x_{THA}}{a_{THA}}\right)^2+\left(\frac{y}{b_{THA}}\right)^2+\left(\frac{z-z_{THA}}{c_{THA}}\right)^2\leq 1. \qquad \text{Eq. 2.73}$$

The third ventricle: Located between the two thalami is the third ventricle. It is represented by an elliptical cylinder parallel to the y-axis and centered at y = 0.0. The region is longer in the z-direction than in the x-direction. It is defined by the equations:

$$\left(\frac{x}{a_{THV}}\right)^2+\left(\frac{z-z_{THV}}{c_{THV}}\right)^2\leq 1 \text{ and } -y_{THV}\leq y\leq y_{THV}. \qquad \text{Eq. 2.74}$$

The lateral ventricles: The lateral ventricles are modeled as two symmetrical cylinders centered at y = 0.0. They are located just below the internal portion (longitudinal fissure) of the cerebral cortex. Their defining equations are:

$$\left(\frac{x \pm x_{LAV}}{R_{LAV}}\right)^2 + \left(\frac{z - z_{H2}}{R_{LAV}}\right)^2 \leq 1 \text{ and } -y_{LAV} \leq y \leq y_{LAV}. \qquad \text{Eq. 2.75}$$

The caudate nuclei: The bodies of the caudate nuclei are represented by two symmetrical cylinders. Each cylinder is then capped on one side by a sphere representing the head of the caudate nucleus. In a single hemisphere, one caudate nucleus is located between one lateral ventricle and one lentiform nucleus. The equations for the caudate nuclei are given below.

For the body of the caudate nuclei:

$$\left(\frac{x \pm x_{CAN}}{R_{CAN}}\right)^2 + \left(\frac{z - z_{CAN}}{R_{CAN}}\right)^2 \leq 1 \text{ and } y_{CAN} \leq y \leq R_{HCAN}. \qquad \text{Eq. 2.76}$$

For the head of the caudate nuclei:

$$\left(\frac{x \pm x_{CAN}}{R_{HCAN}}\right)^2 + \left(\frac{y - y_0}{R_{HCAN}}\right)^2 + \left(\frac{z - z_{CAN}}{R_{HCAN}}\right)^2 \leq 1 \text{ and } y \leq y_{CAN}, \text{ with} \qquad \text{Eq. 2.77}$$

$$y_0 = y_{CAN} - \sqrt{R_{HCAN}^{\;2} - R_{CAN}^{\;2}}. \qquad \text{Eq. 2.78}$$

The lentiform nuclei: Surrounding the outside portion of each thalamus and the bottom part of each caudate nucleus are two elliptical shapes representing the lentiform nuclei defined as the combination of the putamen and the globus pallidus. These elliptical shapes are cut by the intersecting volumes of the caudate nucleus and thalamus in their respective hemispheres. The equations for this region are given below.

$$\left(\frac{x \pm x_{LEN}}{a_{LEN}}\right)^2 + \left(\frac{y - y_{LEN}}{b_{LEN}}\right)^2 + \left(\frac{z - z_{LEN}}{c_{LEN}}\right)^2 \leq 1, \qquad \text{Eq. 2.79}$$

$$\left(\frac{x \pm x_{THA}}{a_{THA}}\right)^2 + \left(\frac{y}{b_{THA}}\right)^2 + \left(\frac{z - z_{THA}}{c_{THA}}\right)^2 \geq 1, \text{ and} \qquad \text{Eq. 2.80}$$

$$\left(\frac{x \pm x_{CAN}}{R_{CAN}}\right)^2 + \left(\frac{z - z_{CAN}}{R_{CAN}}\right)^2 \geq 1 \text{ when } y_{CAN} \leq y \leq R_{HCAN}. \qquad \text{Eq. 2.81}$$

All the inner subregions of the brain described above were derived assuming their growth to be the same as the whole brain (*42*). Then, their position was determined using their relative position within the adult brain.

The white matter: White matter is considered as the remainder tissue interior to the cranium (i.e., all tissue regions within the brain which have not been defined previously).

Calculation of Absorbed Fractions of Energy

Radiation Transport Simulation

The five pediatric head and brain models were incorporated into the Monte Carlo radiation transport code EGS4 (*9, 11*). All the regions defined above were coded, and to allow for photon backscatter, the trunk region defined in the anthropomorphic models derived by Cristy in ORNL Report 8381 (*18*) was also added as a single soft-tissue region positioned below the revised head model. Upon completion of all particle histories, absorbed fractions of energy and their coefficients of variation are calculated for each target region and for each initial particle energy. Let N be the number of particles transported per history set (e.g., 100,000 particles) and let M be the number of history sets run (e.g., 10 sets). For a given source region h, source particle energy E_0, and target region k of interest, the absorbed fraction of energy for the i^{th} history set is calculated as:

$$\phi_i(k \leftarrow h) = \frac{\sum_{j=1}^{N} \varepsilon_{i,j}(k \leftarrow h)}{NE_0}, \qquad \text{Eq. 2.82}$$

where $\varepsilon_{i,j}(k \leftarrow h)$ is the total energy imparted to the target region k from the source region h by the jth particle transported within the ith history set. A single estimate for the mean absorbed fraction of energy, $\bar{\phi}(k \leftarrow h)$, can then be estimated along with its sample standard deviation $s_{\bar{\phi}(k\leftarrow h)}$, given that M history sets of N particles are simulated:

$$\bar{\phi}(k \leftarrow h) = \frac{\sum_{i=1}^{M} \phi_i(k \leftarrow h)}{M}, \text{ and} \qquad \text{Eq. 2.83}$$

$$s_{\bar{\phi}(k\leftarrow h)} = \sqrt{\frac{1}{M(M-1)} \sum_{i=1}^{M} \left[\phi_i(k \leftarrow h) - \bar{\phi}(k \leftarrow h)\right]^2} . \qquad \text{Eq. 2.84}$$

The coefficient of variation (CV) on the mean absorbed fraction of energy is also calculated as:

$$CV(k \leftarrow h) = \frac{s_{\bar{\phi}(k\leftarrow h)}}{\bar{\phi}(k \leftarrow h)} 100\% . \qquad \text{Eq. 2.85}$$

Absorbed Fractions of Energy

Using the EGS4 Monte Carlo code, absorbed fractions of energy are calculated for uniformly distributed monoenergetic sources of both photons and electrons. Twelve energies are simulated between 10 keV and 4 MeV. Fourteen source regions are used including the eight brain subregions, the cranium, the CSF in the cranial region, the thyroid, the spinal skeleton, the spinal CSF, and the brain as a whole. For each of the fourteen sources, all regions in the head and brain model are taken as target regions. For each energy and for each source region, ten sets of 100,000 particles were run (i.e., 1,000,000 particles). Appendix A gives tabulated values of both photon and electron absorbed fractions for all the five pediatric head and brain models, for the fourteen sources, and for sixteen targets. Due to the large number of particles simulated, CVs are typically less than 1% for absorbed fractions greater than 10^{-3}, less than 5% for absorbed fractions greater than 10^{-4}, less than 10% for absorbed fractions greater than 10^{-5}, and less than 25% for absorbed fractions greater than 10^{-6}. Only for absorbed fractions between 10^{-6} and 10^{-7} do CVs range over 100%.

Variation of the Absorbed Fraction with Age

Electron sources

Figure 2.5 shows graphs of self-absorbed fraction versus initial particle energy for four electron sources in a semi-logarithmic scale. For all ages, the self-absorbed fraction is unity at low electron energies below 100 keV. The self-absorbed fraction then decreases at higher initial electron energies. This decrease is more abrupt for smaller head regions such as the newborn thyroid (Figure 2.5-D) than for the larger head regions such as the adult white matter region (Figure 2.5-C). For each of the graphs within Figure 2.5, the self-absorbed fraction curves are in order of increasing age following the increase of region volumes with age. The largest variation with energy is seen when the source is the cranium: this is due to the ellipsoidal shell construction of the cranium (thickness varying from 0.12 cm for the newborn to 0.53 cm for the adult). With such a shape, particle escape is greater than within a large region such as, for example, the white matter. The smallest age variation of the self-absorbed fraction is therefore seen when the white matter or the lentiform nuclei are source regions (Figure 2.5 B and C). When the source is the thyroid (Figure 2.5 D), large variations of the self-absorbed fractions with age are also observed due to the larger changes in the volume of the thyroid from birth to adulthood (1.2 cm^3 for the newborn and 19.9 cm^3 for the adult).

Figure 2.6 gives graphs of the absorbed fractions of energy for electron sources in the white matter for four different targets. Three of the targets are directly adjacent and are located within the brain, and the fourth one is the cranium separated from the white matter by the cerebral cortex and the cranial CSF. For each target, the absorbed fraction begins at zero. At low energies, the ranges of the electrons are too short to deposit energy in the surrounding target regions, and thus all the energy is deposited in the source region. As the initial electron energy increases, the electron range increases and more energy is deposited within the surrounding regions. Small variations in the absorbed fraction with age are seen for the targets within the brain (Figure 2.6 A, B, and D). In these cases, the targets are directly adjacent to the white matter source and they are large enough so that once an electron reaches them, it does not escape, and deposits all its remaining energy within that region. Consequently, for a target region directly adjacent to a source region, the absorbed fraction to the target will be a function of the surface that this target has in common with the source. On the other hand, for a non-adjacent target, such as the cranium (Figure 2.6 C) larger variations of the absorbed fraction with age are seen. In this case, electrons have to go through the cerebral cortex and the cranial CSF before reaching the cranium, which corresponds to a total thickness of 0.64 cm in the newborn model and 1.09 cm in the adult model. The absorbed fraction will therefore be a function of the source-target distance, and will be close to zero until the electron range is large enough to reach the target. For targets that are too far from the source to be reached by the primary electrons, some energy from bremsstrahlung photons will still be deposited.

However, this energy is generally very small and is a function of the source-to-target distance, the volume of the source, and the atomic number of the target. Absorbed fractions seen from bremsstrahlung photons are on the order of 10^{-6} to 10^{-7}.

Examples of absorbed fractions for 1 MeV electrons are as follows. The self-absorbed fraction for the newborn cranium is ~0.45, for the adult cranium ~0.87, for the newborn thyroid ~0.70, and for the adult thyroid ~0.87. The cross-absorbed fractions (source and target regions are different) when the white matter is the source and the cerebral cortex is the target are 0.05 for the newborn and 0.04 for the adult. For the same white matter source and for the lentiform nuclei as the target, the electron absorbed fraction at 1 MeV is 3×10^{-3} for both the newborn and the adult. Also, when the cranium is the target and the white matter is the source, the absorbed fraction is 5×10^{-3} for the newborn and 2×10^{-4} for the adult. The traditional MIRD methodology for nonpenetrating radiations considers 100% of the energy to be deposited within the source region and 0% within the surrounding targets. For the brain subregions, this assumption is invalid for electron energies greater than 200 keV. As the volume of the target decreases and the initial electron energy increases, explicit consideration of electron transport absorbed fraction values deviate from the traditional MIRD assumption.

Photon sources

Figure 2.7 displays four graphs of self-absorbed fractions versus initial particle energy for four photon sources in a logarithmic scale. In these four graphs, the absorbed fraction decreases rapidly with increasing initial photon energy. Between 100 keV and 1 MeV, it remains approximately constant, and then decreases. These variations of the self-absorbed fraction with initial photon energy follow the corresponding variations of the mass energy absorption coefficient for tissue (Figure 2.8). First, due to photoelectric absorption, there is first a sharp decrease below 100 keV. Then, above 100 keV the Compton effect is dominant and the mass energy absorption coefficient remains approximately constant up to about 1-MeV where pair production interactions start to occur. As it was seen for the electrons, the self-absorbed fractions for photons are in order of increasing age (increasing volume). Greater variations with age are also seen at higher energies. The largest variations are seen for the cranium due to its unique shape, and for the thyroid due to its large change in volume with age.

Figure 2.9 gives photon absorbed fraction graphs when the target region is adjacent or very close to the target region. In these graphs, the source region is the white matter and the target regions are the caudate nuclei, the cerebral cortex, the cranium, and the lentiform nuclei. The absorbed fraction initially increases with energy and reaches a maximum at about 20 keV to 30 keV. This increase corresponds to an increase in the number of photons reaching the target where they are fully absorbed. After reaching this maximum, the absorbed fraction follows the same trend as the mass energy absorption coefficient (Figure 2.8). The dependence of the absorbed fraction with age is small for low energies. Some small variations are seen at the energy where a maximum is reached due to the increase in the size of the targets. Above this maximum, larger variations are seen due to the variations in the volume of the target regions with age. The largest age variations are again observed when the cranium is the target (Figure 2.9-C), because of the age dependence in the source-to-target distance.

Figure 2.10 shows graphs of absorbed fractions when the source and target regions are distant from each other. In these graphs, the thyroid is the target region and the whole brain, cranium, lentiform nuclei, and spinal CSF are source regions. The absorbed fraction first increases up to a maximum at about 50 keV, and then remains relatively constant with increasing initial photon energy. In the same figure, the absorbed fraction is seen to vary greatly with age reflecting the changes in both target volumes and source-to-target distances. A simple physical approximation would be to assume the absorbed fraction to follow a point source to point target attenuation, and being proportional to the volume of the target region:

$$\phi(k \leftarrow h) \approx C V_k \frac{e^{-\mu d}}{d^2}, \qquad \text{Eq. 2.86}$$

where C is a proportionality constant, V_k is the volume of the target region, d is the source to target centroid distance, and μ is the photon linear attenuation coefficient. In Table 2.5, we verify this simple approximation by comparing ratios of the absorbed fraction at 4-MeV between a given pediatric head and brain model and the adult. The target region is the thyroid and the source region is the brain or the lentiform nuclei. In the same table, the ratios of the expression given in Equation 2.85 for a given pediatric head model and the adult are also calculated, and relatively good agreement is seen. This simple verification justifies the dependence in target volume and source-to-target distance expressed in Equation 2.85. For both electrons and photons, variations of the absorbed fraction with energy and with age are summarized in Table 2.6.

Calculation of S Values

The mean absorbed dose to the target region per unit cumulated activity in the source region (S value) has been calculated for a variety of radionuclides of interest in nuclear medicine brain imaging, as well as those radionuclides which localize specifically in the cranium, spinal skeleton, and thyroid. These results are listed in Appendix B for all the pediatric models. The list of radionuclides and source regions considered is shown in Table 2.7. In these calculations, the radionuclide decay data files of Eckerman et al. (*47, 48*) have been used in which the beta-particle and positron energy spectra are finely divided into logarithmic intervals. The absorbed fractions for photon sources are used for all photon radiation components of the decay scheme. The absorbed fractions for electron sources are used for all beta-particle and positron radiation components. Alpha particles from ^{226}Ra were assumed to fully deposit their kinetic energy within the various skeletal source regions (i.e., a nonpenetrating radiation).

Explicit Treatment of Positron Transport

A variety of positron-emitting radionuclides are used in brain imaging in conjunction with positron emission tomography (PET). Current MIRD methods for calculating absorbed fractions for positron emitters consider separately the contributions by the positron itself and its associated annihilation photons (*5*). First, the positron is assumed to deposit its initial kinetic energy totally within the source region with no particle escape (nonpenetrating radiation). Second, all positron annihilations are assumed to occur at rest yielding two 0.511 MeV photons emitted back-to-back in an isotropic fashion. The absorbed fraction for each annihilation photon in a given source region is assumed to equal that calculated for monoenergetic 0.511-MeV photons uniformly distributed within that source region.

If the source region dimensions are comparable to the range of the positron, and if the positron is emitted at a relatively high energy, these traditional assumptions may no longer hold true. Two additional factors might be considered. First, in small regions such as those within the current head and brain models, annihilation events can occur outside the source region (e.g., a positron emitted within the cerebral cortex might annihilate within the cranium). Second, not all positrons would annihilate at rest and thus photon energies exceeding 0.511 MeV might be considered.

The EGS4 code allows for the explicit transport of positrons and thus the degree to which these traditional assumptions are valid can be investigated. The transport of positrons was then simulated within the brain subregions of the newborn model. The average initial energy of the annihilation photons was first recorded. Next, the absorbed fractions of energy from the annihilation photons and from the positrons themselves were calculated independently as a function of the initial positron energy. For the calculations of these absorbed fractions, the average initial annihilation photon energy and the average total energy deposited by the positrons were used so that both absorbed fractions sum to 100% for all head and brain regions. Figure 2.11-A shows the average initial energy of the annihilation photons as a function of the initial positron energy. At initial positron energies of ~500 keV, the average initial energy of the annihilation photons increases with a rapid increase occurring at energies above 1 MeV. At a positron energy of 1 MeV, the annihilation photons have an average initial energy of 521 keV. At 2 MeV, annihilation photons are created with an average initial energy of 537 keV; at 4 MeV, photons of average initial energy 583 keV are produced. Figure 2.11-B shows the calculated self-absorbed fractions of energy from the annihilation photons for the cerebral cortex and the caudate nuclei. In the same graph, the absorbed fractions calculated using the traditional assumption of uniform 0.511 MeV photons are indicated as horizontal lines. Differences, between the Monte Carlo results and those using the traditional method start to appear at positron energies greater than 1 MeV. Those differences are greater for the caudate nuclei which is a smaller region than the cerebral cortex. In comparing the absorbed fraction of energy contributed by the positron particle itself with electrons of similar initial kinetic energy, no statistically significant differences were seen.

The S values for positron sources can be calculated considering the explicit transport of positrons and their annihilation photons. In this case, for each positron energy within the radionuclide emission spectrum, the contribution of its annihilation photons to the total S value must also be calculated:

$$S(k \leftarrow h) = \sum_i \left[S_{annih,E_{0i}}(k \leftarrow h) + S_{pos,E_{0i}}(k \leftarrow h)\right], \text{ with} \qquad \text{Eq. 2.87}$$

$$S_{annih,E_{0i}}(k \leftarrow h) = \sum_i \left[n_i E_{annih}(E_{0i}) \Phi_{annih,E_{0i}}(k \leftarrow h)\right], \text{ and} \qquad \text{Eq. 2.88}$$

$$S_{pos,E_{0i}}(k \leftarrow h) = \sum_i \left[n_i E_{pos}(E_{0i}) \Phi_{pos,E_{0i}}(k \leftarrow h)\right]. \qquad \text{Eq. 2.89}$$

In these equations, n_i represents the number of positrons of energy E_{0i} emitted per nuclear transition, $E_{annih}(E_{0i})$ is the average initial energy of the annihilation photons from positron of initial energy E_{0i}, $E_{pos}(E_{0i}) = E_{0i} - (E_{annih}(E_{0i}) - m_e c^2)$ is the average total kinetic energy deposited by the positron of energy E_{0i}, $\Phi_{annihi,E0i}$ is the annihilation photon specific absorbed fraction from positrons of initial energy E_{0i}, and $\Phi_{pos,E0i}$ is the specific absorbed fraction for the positrons of initial energy E_{0i}.

In the list of radionuclides chosen for the tabulation of S values (Table 2.7), ten are positrons emitters. Table 2.8 gives the average and maximum energy of those radionuclides. This table also compares the S values calculated with explicit consideration of positron transport, and that calculated under the traditional assumption of a uniform 0.511-MeV photon source with electron transport. Two source and four target regions are considered. The ratios between the two calculated S values are given for all ten radionuclides. There are almost no differences, except at high positron energies, for ^{57}Cu, where differences of 5 to 14% are seen for several source-target combinations. One may conclude then that, for positron emitters with relatively low average energies, S value calculations may be accurately performed with the traditional assumption of a uniform source of electrons and with a uniform source of 0.511-MeV photons.

Conclusion

Five new pediatric head and brain models have been developed based on the newly adopted adult MIRD dosimetric model of the head and brain. A full set of six models with a newborn, 1-year-old, 5-year-old, 10-year-old, 15-year-old, and an adult is now available for suborgan head and brain dosimetry. These models include new regional source and target structures within the brain which are necessary to support the suborgan brain dosimetry of current and developing neuroimaging agents. Improvements include the incorporation of eyes, a more detailed facial skeleton, and a separate neck region. The inclusion of a neck region will circumvent the need for repositioning the thyroid gland when the model is used to estimate thyroid doses from external radiation fields incident from varying directions. This will also allow for a better estimate of the dose to the spinal region from anterior irradiation.

While the S values tabulated in this dissertation are designed to yield estimates of radiation absorbed dose to the subregions within an average human brain and head of a given age, the reader should realize that the calculations are based on specific mathematical models. If patient-specific subregion volumes are available for a given patient from imaging modalities such as MRI or CT, the radionuclide S values given in Appendix B may be mass adjusted as suggested in the MIRD Perspective 1998 (*7*) and in MIRD Pamphlet No. 11 (*5*). Furthermore, due to large variations in the brain volumes for children of a given age, if the mass of the brain is known, the calculations should be performed using the model with the closest mass, independent of the model's reference age. If the mass is not known, the circumference of the cranium can be used to better match the patient to one of the mathematical models (Table 2.9).

Table 2.1: Description of the parameters used in the mathematical equations of the head and brain regions.

Head region parameters	Description
BRAIN	
a_{BR}	Half X-axis of the brain (cerebral cortex)
b_{BR}	Half Y-axis of the brain (cerebral cortex)
c_{BR1}	Half upper Z-axis of the brain (cerebral cortex)
c_{BR2}	Half lower Z-axis of the brain (cerebral cortex)
y_{BR}	Y-limit of the back of the cerebral cortex
t_{CC}	Thickness of the cerebral cortex
CAUDATE NUCLEI	
R_{CAN}	Radius of the caudate nuclei
R_{HCAN}	Radius of the head of the caudate nuclei
x_{CAN}	X-position of the center of the head of the caudate nuclei
y_{CAN}	Y-front-limit of the cylinder of the caudate nuclei
z_{CAN}	Z-position of the center of the head of the caudate nuclei
CRANIUM	
a_{CR}	Half X-axis of the cranium
b_{CR}	Half Y-axis of the cranium
c_{CR1}	Half upper Z-axis of the cranium
c_{CR2}	Half lower Z-axis of the cranium
t_{CR}	Thickness of the cranium
t_{CSF}	Thickness of the cranial CSF
EYES	
R_{EY}	Radius of the eyes
x_{EY}	X-position of the center of the eyes
y_{EY}	Y-position of the center of the eyes
z_{EY}	Z-position of the center of the eyes

Table 2.1: Continued.

Head region parameters	
HEAD	
a_H	Half X-axis of the head (cylinder and ellipsoid)
b_H	Half Y-axis of the head (cylinder and ellipsoid)
c_H	Half Z-axis of the head (ellipsoid)
y_H	Y-position of separation between head cylinder and cone
z_{H1}	Upper Z-limit of the neck
z_{H2}	Upper Z-limit of the cylinder of the head
C_T	Lower Z-limit of the neck (it is the length of the trunk)
R_N	Radius of the neck
y_N	Y-position of the axis of the neck
S	Thickness of the skin
LATERAL VENTRICLES	
R_{LAV}	Radius of the lateral ventricles
x_{LAV}	X-position of the axis of the lateral ventricles
y_{LAV}	Y-limit for the lateral ventricles
LENTIFORM NUCLEI	
a_{LEN}	Half X-axis of the lentiform nuclei
b_{LEN}	Half Y-axis of the lentiform nuclei
c_{LEN}	Half Z-axis of the lentiform nuclei
x_{LEN}	X-position of the center of the lentiform nuclei
y_{LEN}	Y-position of the center of the lentiform nuclei
z_{LEN}	Z-position of the center of the lentiform nuclei
MANDIBLE	
a_{MA1}	Half X-axis of the mandible (front and back)
b_{MA1}	Half Y-axis of the mandible (front and back)
a_{MA2}	Half X-axis of the mandible (front)
b_{MA2}	Half Y-axis of the mandible (front)
a_{MA3}	Half X-axis of the mandible (back)
b_{MA3}	Half Y-axis of the mandible (back)
y_{MA}	Y-limit of the mandible (front and back)
z_{MA1}	Lower Z-limit of the mandible (front and back)
z_{MA2}	Upper Z-limit of the mandible (front)

Table 2.1: Continued.

Head region parameters	
SPINE	
a_{SP}	Half X-axis of the spinal skeleton
b_{SP}	Half Y-axis of the spinal skeleton
R_{SP1}	Radius of the spinal CSF
R_{SP2}	Radius of the spinal column
y_{SP}	Y-position of the axis of the spine
TEETH	
a_{TE1}	Half X-axis of the teeth
b_{TE1}	Half X-axis of the teeth
a_{TE2}	Half X-axis of the teeth
b_{TE2}	Half X-axis of the teeth
z_{TE}	Upper Z-limit of the teeth
THALAMI	
a_{THA}	Half X-axis of the thalami
b_{THA}	Half Y-axis of the thalami
c_{THA}	Half Z-axis of the thalami
x_{THA}	X-position of the center of the thalami
z_{THA}	Z-position of the center of the thalami
THIRD VENTRICLE	
a_{THV}	Half X-axis of the third ventricle
c_{THV}	Half Z-axis of the third ventricle
y_{THV}	Y-limit for the third ventricle
z_{THV}	Z-position of the axis of the third ventricle
THYROID	
R_{THY1}	Radius of the outer cylinder of the thyroid
R_{THY2}	Radius of the inner cylinder of the thyroid
y_{THY}	Y-position of the axis of the thyroid
UPPER-FACE	
a_{UF}	Half X-axis of the upper face region
b_{UF}	Half Y-axis of the upper face region

Table 2.2: Value of the mathematical parameters describing the regions of the head and brain for all ages (in cm).

Head region parameters	0	1	5	10	15	Adult
BRAIN						
a_{BR}	4.44	6.21	6.63	6.72	6.90	7.12
b_{BR}	5.69	7.56	8.43	8.70	8.70	9.18
c_{BR1}	3.89	4.11	5.00	5.02	5.07	5.18
c_{BR2}	3.55	5.00	5.88	6.00	6.05	6.28
y_{BR}	3.30	3.60	3.90	4.12	4.12	4.50
t_{CC}	0.62	0.83	0.88	1.00	1.00	1.00
CAUDATE NUCLEI						
R_{CAN}	0.35	0.49	0.55	0.55	0.57	0.57
R_{HCAN}	0.48	0.62	0.70	0.73	0.73	0.75
x_{CAN}	1.44	1.96	2.13	2.20	2.24	2.25
y_{CAN}	-1.83	-2.30	-2.57	-2.68	-2.67	-2.80
z_{CAN}	29.99	43.33	54.70	66.12	79.35	87.10
CRANIUM						
a_{CR}	4.46	6.24	6.69	6.79	6.98	7.21
b_{CR}	5.71	7.59	8.49	8.77	8.78	9.27
c_{CR1}	3.91	4.14	5.06	5.09	5.15	5.27
c_{CR2}	3.57	5.03	5.94	6.07	6.13	6.37
t_{CR}	0.12	0.18	0.33	0.41	0.45	0.53
t_{CSF}	0.02	0.03	0.05	0.07	0.08	0.09
EYES						
R_{EY}	0.86	0.92	1.09	1.14	1.14	1.22
x_{EY}	1.80	2.40	2.85	3.10	3.25	3.40
y_{EY}	-4.40	-6.20	-6.70	-7.00	-7.06	-7.50
z_{EY}	28.19	41.36	52.65	63.68	76.72	84.20

Table 2.2: Continued.

Head region parameters	**0**	**1**	**5**	**10**	**15**	**Adult**
HEAD						
a_H	4.58	6.42	7.01	7.20	7.43	7.74
b_H	5.83	7.77	8.81	9.18	9.23	9.80
c_H	4.03	4.32	5.38	5.50	5.60	5.80
y_H	2.88	3.85	4.36	4.54	4.53	4.80
z_{H1}	23.67	32.99	43.65	54.53	67.47	75.20
z_{H2}	30.59	44.06	55.55	66.98	80.22	88.00
C_T	21.60	30.70	40.80	50.80	63.10	70.00
R_N	2.57	3.61	4.00	4.38	4.83	5.81
y_N	1.61	1.97	2.33	2.21	1.78	1.20
S	0.07	0.08	0.09	0.10	0.17	0.20
LATERAL VENTRICLES						
R_{LAV}	0.48	0.64	0.75	0.78	0.79	0.80
x_{LAV}	0.59	0.87	0.93	0.94	0.97	1.00
y_{LAV}	1.73	2.34	2.40	2.41	2.44	2.50
LENTIFORM NUCLEI						
a_{LEN}	0.78	1.08	1.09	1.11	1.13	1.13
b_{LEN}	1.18	1.58	1.83	1.86	1.90	1.90
c_{LEN}	0.95	1.21	1.46	1.48	1.50	1.50
x_{LEN}	1.21	1.70	1.81	1.87	1.94	1.95
y_{LEN}	-0.52	-0.92	-1.00	-1.05	-1.05	-1.20
z_{LEN}	29.16	42.32	53.47	64.86	78.03	85.80
MANDIBLE						
a_{MA1}	3.66	5.31	5.80	5.95	6.14	6.40
b_{MA1}	3.24	4.32	4.90	5.11	5.13	5.45
a_{MA2}	2.01	2.82	3.08	3.18	3.26	3.40
b_{MA2}	2.38	3.06	3.47	3.62	3.64	3.86
a_{MA3}	2.48	3.48	3.80	3.93	4.03	4.20
b_{MA3}	4.81	6.18	7.01	7.31	7.35	7.80
y_{MA}	-2.49	-3.21	-3.64	-3.79	-3.81	-4.05
z_{MA1}	23.85	33.27	44.24	55.00	68.00	75.50
z_{MA2}	25.10	35.29	46.24	56.76	69.67	77.40

Table 2.2: Continued.

Head region parameters	0	1	5	10	15	Adult
SPINE						
a_{SP}	1.55	1.95	2.17	2.17	2.17	2.17
b_{SP}	1.25	1.55	1.67	1.67	1.67	1.67
R_{SP1}	0.57	0.68	0.77	0.77	0.77	0.77
R_{SP2}	0.32	0.40	0.43	0.43	0.43	0.43
y_{SP}	2.58	3.32	3.83	3.86	3.62	3.41
TEETH						
a_{TE1}	2.72	3.81	4.16	4.28	4.42	4.60
b_{TE1}	3.20	4.12	4.67	4.84	5.13	5.20
a_{TE2}	2.03	2.85	3.12	3.20	3.26	3.44
b_{TE2}	2.90	3.73	4.22	4.40	4.64	4.70
z_{TE}	26.43	37.31	48.49	59.25	72.22	80.00
THALAMI						
a_{THA}	0.55	0.74	0.85	0.87	0.89	0.90
b_{THA}	0.92	1.18	1.25	1.27	1.28	1.30
c_{THA}	0.98	1.28	1.53	1.56	1.57	1.60
x_{THA}	0.72	1.05	1.10	1.13	1.18	1.15
z_{THA}	29.13	42.11	53.25	64.65	77.85	85.60
THIRD VENTRICLE						
a_{THV}	0.09	0.14	0.15	0.15	0.15	0.15
c_{THV}	0.78	0.99	1.05	1.05	1.07	1.10
y_{THV}	0.70	0.85	1.10	1.15	1.17	1.20
z_{THV}	29.26	42.42	53.65	65.06	78.28	86.00
THYROID						
R_{THY1}	0.87	0.97	1.21	1.60	1.85	2.20
R_{THY2}	0.40	0.44	0.55	0.73	0.83	1.00
y_{THY}	0.45	0.56	1.08	0.50	-0.13	-1.09
UPPER-FACE						
a_{UF}	4.10	5.74	6.27	6.44	6.65	6.93
b_{UF}	5.83	7.61	8.63	8.99	9.04	9.60

Table 2.3: Volumes of regions defined within the new head and brain models (cm^3).

Head region	**0**	**1**	**5**	**10**	**15**	**Adult**
Brain (total)	371.9	838.4	1194.0	1264.4	1310.2	1467.6
Caudate Nuclei	2.6	6.2	8.8	9.5	9.9	10.5
Cerebellum	21.4	83.4	122.0	125.9	130.4	139.1
Cerebral Cortex	160.2	353.7	485.4	557.5	571.6	622.4
Cranial CSF	5.0	13.3	30.4	40.3	44.5	56.9
Cranium	30.9	81.1	188.3	250.2	284.5	364.6
Eyes	5.3	6.5	10.9	12.4	12.4	15.2
Head (include neck and skin)	835.8	2216.2	3068.3	3490.6	3872.4	4564.9
Lateral Ventricles	5.0	12.0	17.0	18.4	19.1	20.1
Lentiform Nuclei	4.7	11.4	15.9	17.5	18.5	19.4
Mandible	32.1	109.8	133.0	139.4	144.8	170.5
Neck (including the skin)	43.8	94.5	145.1	228.9	329.9	567.4
Remaining Head Tissues	267.9	833.1	1076.3	1271.3	1425.3	1763.2
Skin	29.9	65.5	92.1	114.7	214.8	280.1
Spinal Cord	1.8	4.4	5.3	6.0	6.4	6.8
Spinal CSF	4.0	8.2	11.7	13.2	14.2	14.9
Spinal Skeleton	29.3	70.5	88.1	99.3	106.5	111.8
Teeth	5.9	16.1	22.1	26.0	30.2	31.2
Thalami	4.2	9.4	13.6	14.4	19.0	15.7
Third Ventricle	0.3	0.7	1.1	1.1	1.2	1.2
Thyroid	1.2	1.7	3.3	7.6	11.9	19.9
Trunk	2111.4	5516.8	11007.2	18634.1	33511.5	43982.3
Upper Face Region	46.7	155.6	187.4	226.2	246.2	265.5
White Matter	172.7	359.5	528.2	518.6	542.9	639.2

Table 2.4: Elemental composition of the soft tissue and bone regions (*18*).

	Percent by Weight			
	All models (except newborn)		Newborn	
Element	Soft tissue	Bone regions	Soft tissue	Bone regions
H	10.454	7.337	10.625	7.995
C	22.663	25.475	14.964	9.708
N	2.490	3.057	1.681	2.712
O	63.525	47.893	71.830	66.811
F	0.000	0.025	0.000	0.000
Na	0.112	0.326	0.075	0.314
Mg	0.013	0.112	0.019	0.143
Si	0.030	0.002	0.000	0.000
P	0.134	5.095	0.179	3.712
S	0.204	0.173	0.240	0.314
Cl	0.133	0.143	0.079	0.140
K	0.208	0.153	0.301	0.148
Ca	0.024	10.190	0.003	7.995
Fe	0.005	0.008	0.004	0.008
Zn	0.003	0.005	0.000	0.000
Rb	0.001	0.002	0.000	0.000
Sr	0.000	0.003	0.000	0.000
Zr	0.001	0.000	0.000	0.000
Pb	0.000	0.001	0.000	0.000
Density	1.04 g cm^{-3}	1.4 g cm^{-3}	1.04 g cm^{-3}	1.22 g cm^{-3}

Table 2.5: Ratios of the photon absorbed fractions at 4 MeV for a given pediatric head model and the adult head model when the target region is the thyroid and the source region the whole brain or the lentiform nuclei, as given by the Monte Carlo transport code, and by Equation 85.

Source region	**Newborn**	**1**	**5**	**10**	**15**	**Adult**
From Monte Carlo						
Brain	3.7	7.2	5.5	2.1	1.6	1.0
Lentiform Nuclei	3.4	6.9	4.7	2.1	1.5	1.0
From Equation 85						
Brain	3.4	6.6	4.2	2.2	1.5	1.0
Lentiform Nuclei	3.2	6.7	4.1	2.2	1.5	1.0

Table 2.6: Summary of the variations of the absorbed fractions with the initial energy of the particle and with the age of the model for photon and electron sources.

		electrons	
Self	2.5	• $\phi \approx 1$ up to 100 keV • Decreases above 100 keV • MIRD assumption not valid above 100 to 300 keV	• More abrupt decrease for smaller volumes • Largest variations for shell-shaped regions (such as the cranium) • Smallest variations for large regions (such as the white matter)
Cross: adjacent and close targets	2.6	• $\phi \approx 0$ up to 100 keV • Increases above 100 keV • MIRD assumption not valid above 100 to 300 keV	• Small variations for adjacent targets • Larger variations for nonadjacent targets (depends on distance to source) • Proportional to the source surface area directly in contact with the target
Cross: distant targets		• Equals to zero, except at high energy due to bremsstrahlung photons	• ϕ function of the target volume, the source-to-target distance, and the effective atomic number of the source region
		Photons	
Self	2.7	• ϕ decreases rapidly at energies less than 100 keV • Remains constant between 100 keV and 1 MeV • Decreases slightly above 1 MeV • Follows the same trends as μ_{en}/ρ versus photon energy	• Greater variation at high energy • Absorbed fractions increase with target volume • Largest variations for shell-shape regions • Smallest variations for full-shape regions
Cross: adjacent and close targets	2.9	• Increases rapidly to a maximum at 20-keV to 30-keV • After the maximum, follows the same trend as μ_{en}/ρ versus energy	• More variations above the maximum absorbed fraction • Absorbed fraction increases with target volume • Larger variations for nonadjacent and close targets (depends on distance to source)
Cross: distant targets	2.10	• Increases rapidly to a maximum at ~50 keV • After the maximum, remains relatively constant	• Large variations with age at all energies • Varies proportionally to the target volume • Varies as $\exp(-\mu\ d)/d^2$ where d is the source/target distance

Table 2.7: List of radionuclides used for the calculation of radionuclide S values.

Regions	Radionuclides
Brain as a whole, Caudate Nuclei, Cerebellum, Cerebral Cortex, Cranial CSF, Lateral Ventricles, Lentiform Nuclei, Spinal CSF, Thalami, Third Ventricle, White Matter	^{11}C, ^{13}N, ^{15}O, ^{18}F, ^{32}P, ^{57}Cu, ^{62}Cu, ^{64}Cu, ^{67}Cu, ^{76}Br, ^{82}Rb, ^{85}Kr, ^{99m}Tc, ^{122}I, ^{123}I, ^{124}I, ^{125}I, ^{130}I, ^{131}I, ^{132}I, ^{133}Xe, ^{197}Hg, ^{201}Tl, ^{203}Hg.
Cranium, Spinal Skeleton	^{32}P, ^{33}P, ^{89}Sr, ^{90}Sr, ^{90}Y, ^{99m}Tc, ^{131}Cs, ^{131}I, ^{153}Sm, ^{186}Re, ^{188}Re, ^{226}Ra
Thyroid	^{99m}Tc, ^{122}I, ^{123}I, ^{124}I, ^{125}I, ^{125m}I, ^{126}I, ^{130}I, ^{131}I, ^{132}I, ^{132m}I, ^{133}I

Table 2.8: Comparison of S values for positron emitters calculated from explicit consideration of the transport of positrons and annihilation photons, and from electron and photon absorbed fraction results.

	^{18}F	^{11}C	^{13}N	^{15}O	^{124}I	^{76}Br	^{62}Cu	^{122}I	^{82}Rb	^{57}Cu
E_{avg} (MeV)	0.25	0.39	0.49	0.74	0.82	1.17	1.31	1.37	1.47	3.6
E_{max} (MeV)	0.60	0.90	1.10	1.60	2.00	3.60	2.80	3.00	3.20	7.5
				S value (e+)/S value (e-)						
Target				Source = Caudate Nuclei						
Caud. Nucl.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.04
Cereb. Cort.	1.00	1.00	1.00	1.01	1.00	1.01	1.03	1.04	1.03	1.05
Cranium	1.00	1.00	1.00	1.01	1.00	1.01	1.03	1.04	1.03	1.08
Eyes	0.98	0.98	0.99	0.99	1.00	1.00	1.01	1.02	1.01	1.14
Target				Source = Cerebral Cortex						
Caud. Nucl.	1.01	1.00	1.00	1.01	1.00	1.00	1.01	1.01	1.01	0.95
Cereb. Cort.	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99
Cranium	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.95
Eyes	1.05	1.05	1.05	1.06	1.01	1.01	1.04	1.03	1.03	1.03

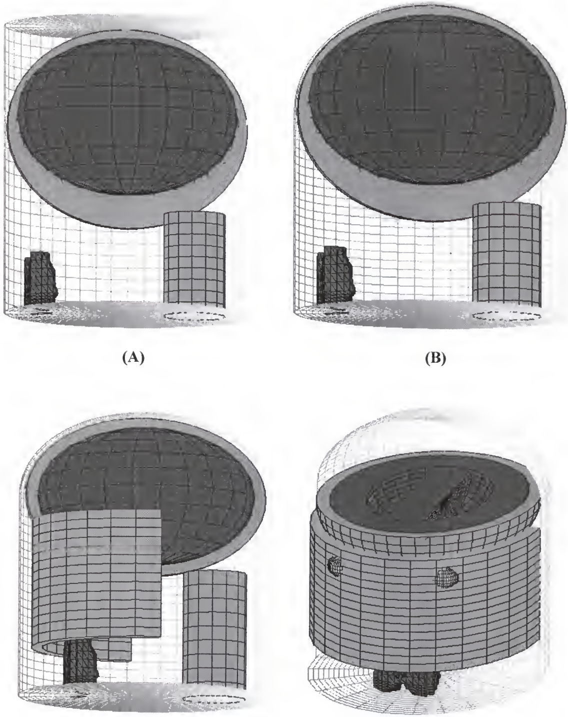
Table 2.9: Head Circumference of the Phantom Series.

Phantom	Head Breadth[*] (cm)	Head Length[†] (cm)	Head Circumference[‡] (cm)
Newborn	4.65	6.00	33.6
1-year-old	6.50	7.85	45.2
5-year-old	7.10	8.90	50.4
10-year-old	7.30	9.28	52.3
15-year-old	7.60	9.40	53.6
Adult	7.94	10.00	56.5

[*] Distance between the left and the right side of the head.

[†] Distance between the back and the front of the head.

[‡] Calculated using Maple 5.



(A) (B)

(C) (D)

Figure 2.1: Three-dimensional representation of 4 adult dosimetric models of the head and brain. (A) The 1968 MIRD 5 model (*19*), (B) the 1978 MIRD 5R model (*20*), (C) the 1980 Cristy and Eckerman model (*17, 18*), and (D) the 1980 Eckerman model(*40*).

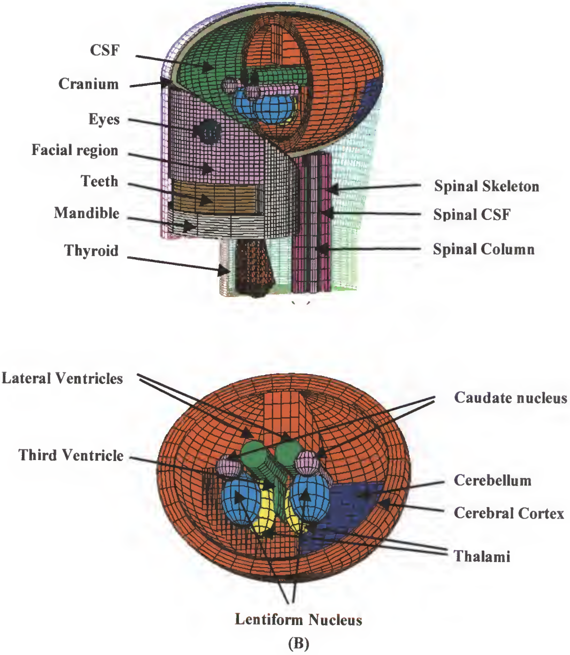


Figure 2.2: Interior features of the new MIRD adult head and brain model (*3*).

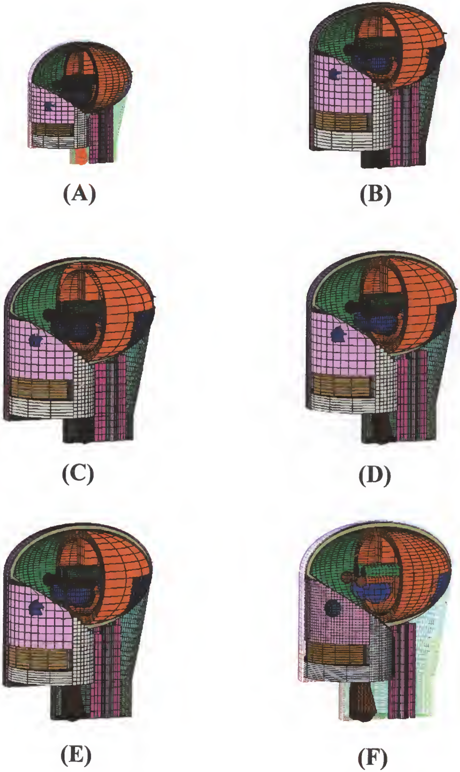


Figure 2.3: Family of head and brain models, with (A) the newborn, (B) the 1-year-old, (C) the 5-year-old, (D) the 10-year-old, (E) the 15-year-old, and (F) the adult model.

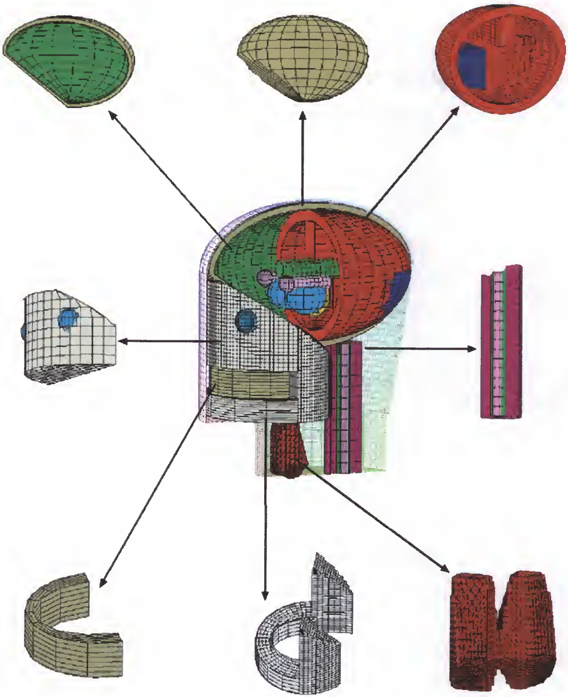
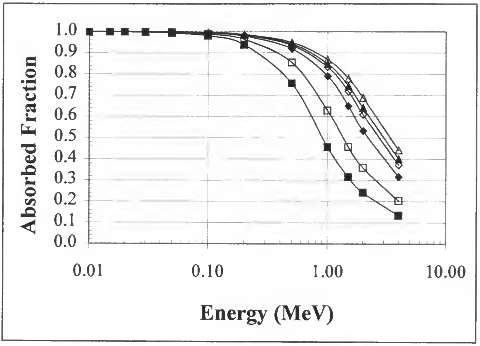
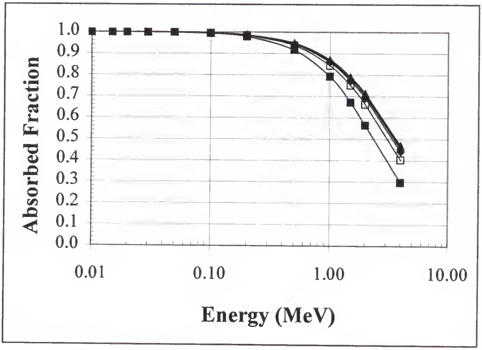


Figure 2.4: Interior features of the new head and brain models. Eight components of the model are also shown which include (starting at the top and running counterclockwise) (a) an exterior view of the cranium, (b) an interior view of the cranium (brain excluded), (c) the upper facial region and eyes, (d) the teeth, (e) the mandible, (f) the thyroid, (g) the three-region spine, and (h) the cerebral cortex (red) and cerebellum (blue).

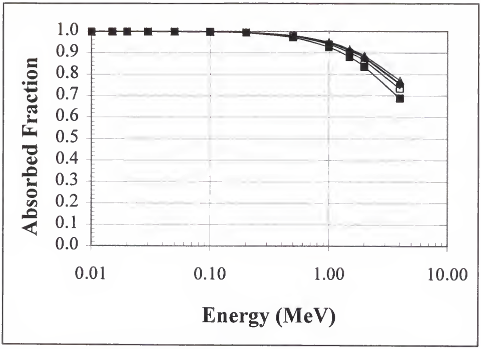


(A): S = cranium, T = cranium

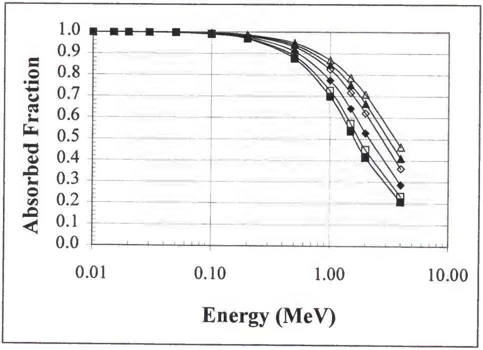


(B): S = lentiform nuclei, T = lentiform nuclei

Figure 2.5: Self absorbed fractions for electron sources within (A) the cranium, (B) the lentiform nuclei, (C) the white matter, and (D) the thyroid. The six models are shown: the adult (△), the 15-year-old (▲), the 10-year-old (◇), the 5-year-old (◆), the 1-year-old (□), and the newborn (■).

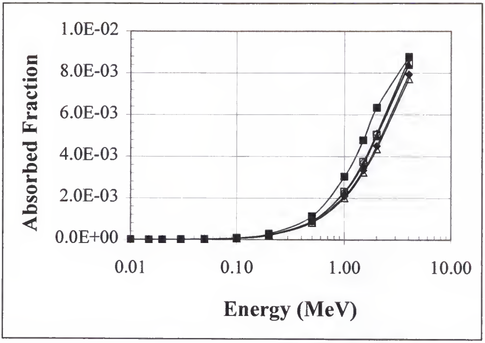


(C): S = white matter, T = white matter

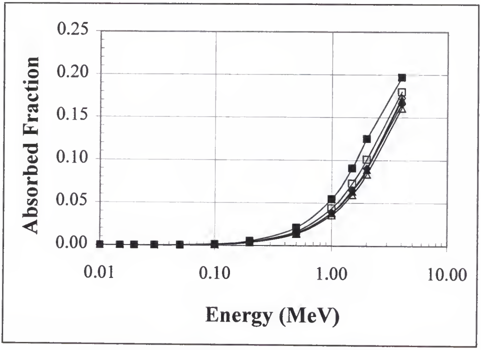


(D): S = thyroid, T = thyroid

Figure 2.5: Continued.

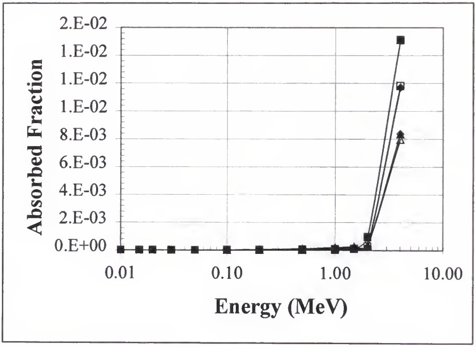


(A): S = white matter, T = caudate nuclei

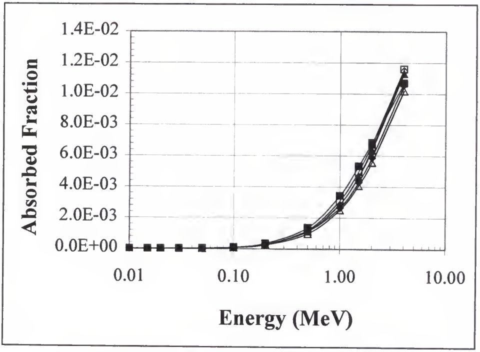


(B): S = white matter, T = cerebral cortex

Figure 2.6: Cross-absorbed fractions for an electron source in the white matter irradiating the following targets: (A) the caudate nuclei, (B) the cerebral cortex, (C) the cranium, and (D) the lentiform nuclei. The six models are shown: the adult (△), the 15-year-old (▲), the 10-year-old (◇), the 5-year-old (◆), the 1-year-old (□), and the newborn (■).

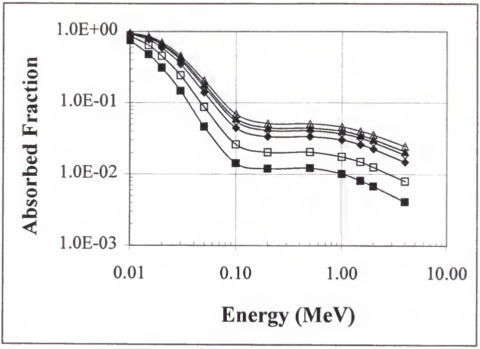


(C): S = white matter, T = cranium

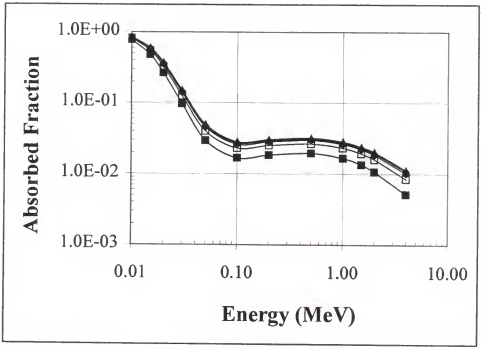


(D): S = white matter, T = lentiform nuclei

Figure 2.6: Continued.

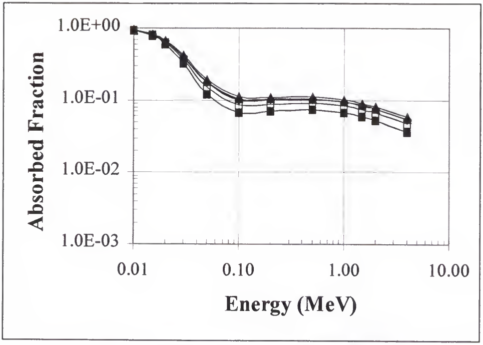


(A): S = cranium, T = cranium

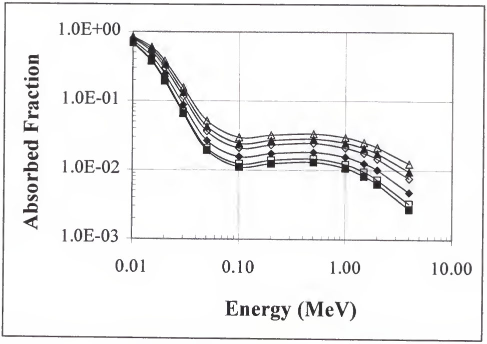


(B): S = lentiform nuclei, T = lentiform nuclei

Figure 2.7: Self-absorbed fractions for photon sources within (A) the cranium, (B) the lentiform nuclei, (C) the white matter, and (D) the thyroid. The six models are shown: the adult (△), the 15-year-old (▲), the 10-year-old (◇), the 5-year-old (◆), the 1-year-old (□), and the newborn (■).



(C): S = white matter, T = white matter



(D): S = thyroid, T = thyroid

Figure 2.7: Continued.

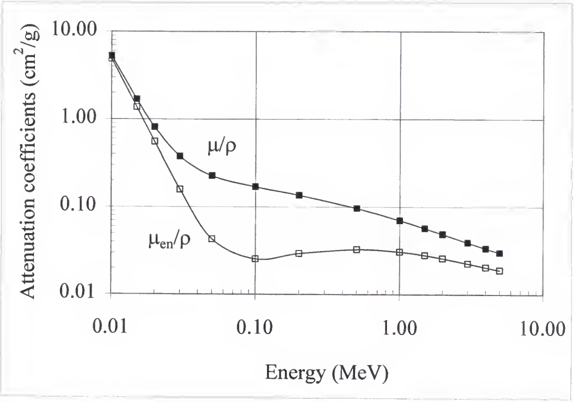
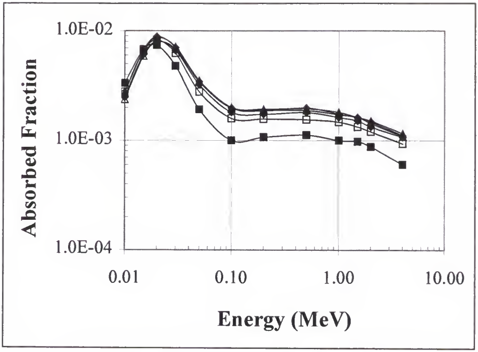
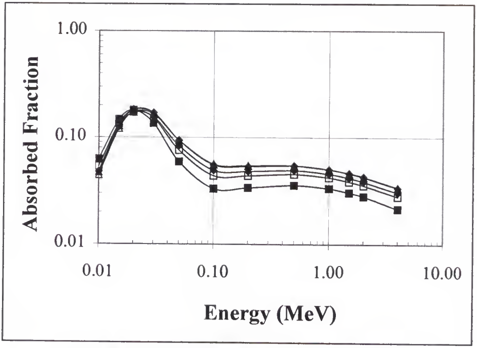


Figure 2.8: Graph of photon mass attenuation coefficients (μ/ρ), and mass energy-absorption coefficients (μ_{en}/ρ) for soft tissue composition.

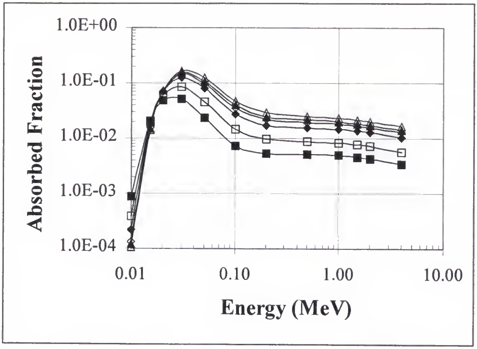


(A): S = white matter, T = caudate nuclei

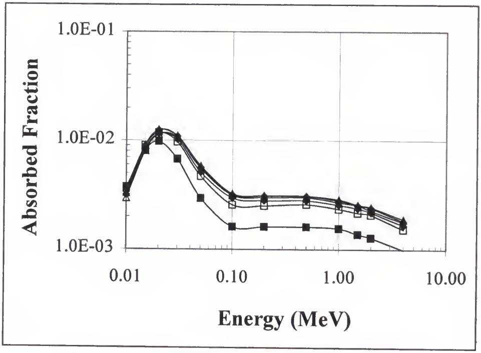


(B): S = white matter, T = cerebral cortex

Figure 2.9: Cross-absorbed fractions for a photon source in the white matter and for targets which include: (A) the caudate nuclei, (B) the cerebral cortex, (C) the cranium, and (D) the lentiform nuclei. The six models are shown: the adult (△), the 15-year-old (▲), the 10-year-old (◇), the 5-year-old (◆), the 1-year-old (□), and the newborn (■).

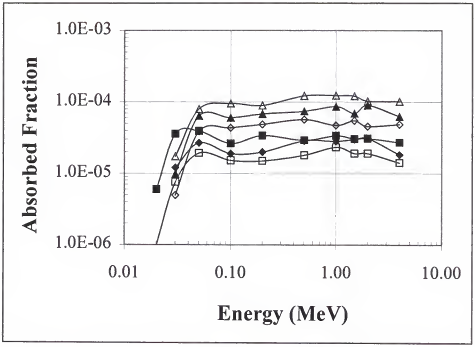


(C): S = white matter, T = cranium

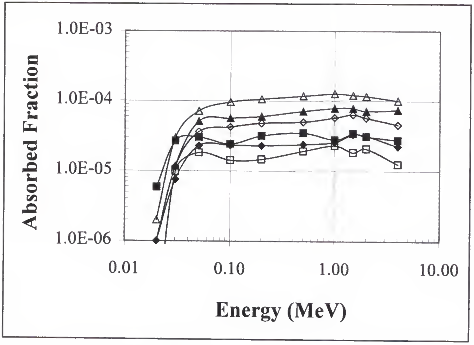


(D): S = white matter, T = lentiform nuclei

Figure 2.9: Continued.

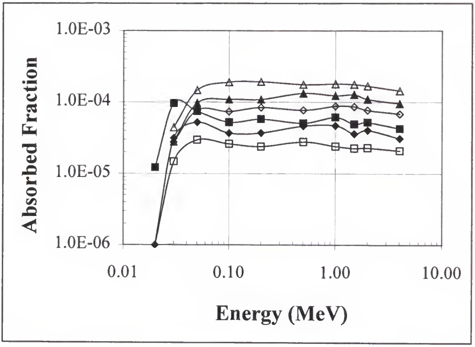


(A): S = brain, T = thyroid

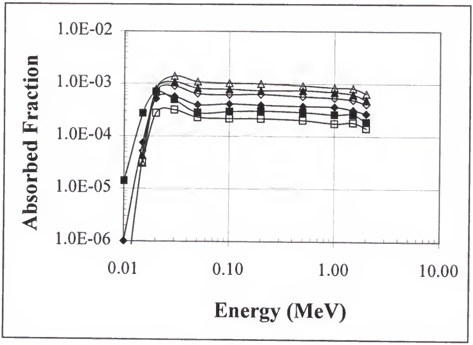


(B): S = cranium, T = thyroid

Figure 2.10: Cross-absorbed fractions to the thyroid for a photon source in the (A) brain, (B) the cranium, (C) lentiform nuclei, and (D) spinal CSF. The six models are shown: the adult (△), the 15-year-old (▲), the 10-year-old (◇), the 5-year-old (◆), the 1-year-old (□), and the newborn (■).

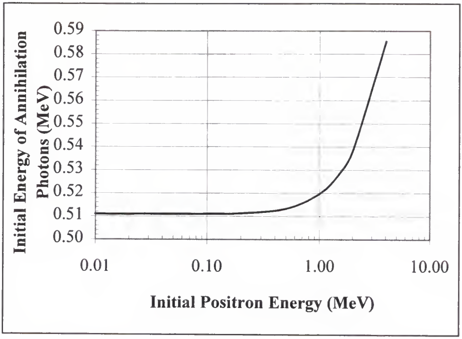


(C): S = lentiform nuclei, T = thyroid

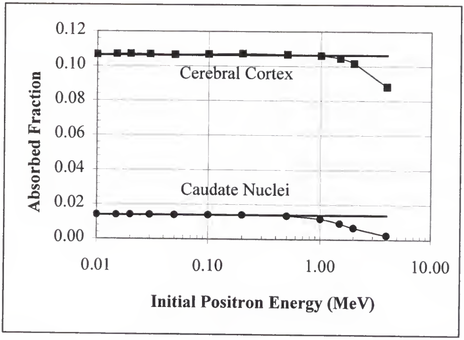


(D): S = spinal CSF, T = thyroid

Figure 2.10: Continued.



(A)



(B)

Figure 2.11: Graphs showing explicit transport of positrons for the newborn model for the caudate nuclei (●) and the cerebral cortex (■) as both the source and target region. In Part (A), the average initial energy of the annihilation photons is plotted as a function of the initial positron energy. In Part (B), the fraction of energy deposited by the annihilation photons in the positron source is plotted. In the same graph, the absorbed fraction for a uniform source of 0.511-MeV photons is shown as horizontal lines.

CHAPTER 3
MODEL OF ELECTRON TRANSPORT IN TRABECULAR BONE

Introduction

In radioimmunotherapy and in radionuclide bone pain palliation, the skeletal system, and more precisely the bone marrow, is the dose-limiting organ (*49-51*). Radiosensitive cells in the human skeletal system have been identified as (a) hematopoietic cells present in bone marrow, (b) endosteal cells lying close to bone surfaces, and (c) epithelial cells close to bone surfaces in the air sinuses of the skull (*52*). Unfortunately, due to the complex microstructure of the skeleton, it has been difficult to accurately calculate the dose deposited to these sensitive tissues.

The human skeletal system is formed of two different structures as shown in Figure 3.1. The first structure is a hard, dense structure called cortical or compact bone. It is found in the shafts of the long bones and in the outer cortex of all bones. The dominant microstructure of the cortical bone is the osteon, which is formed of a central Haversian canal lined with a layer of endosteum and surrounded by bone lamellae. The dosimetrically important region in the cortical bone is principally the osteogenic cells within the endosteal layer. A new dosimetric model of the cortical bone is presented in a companion paper by Bouchet and Bolch (*53*).

The second structure of the skeletal system is a porous, spongy structure called the trabecular or cancellous bone. Trabecular bone is found in the interior of the flat bones and at the ends of the long bones. It is formed of a complex network of bone trabeculae and tissue cavities. Each cavity is lined by a layer of osteogenic cells called the endosteum and is filled with marrow that can be either hematopoietically active (red marrow) or inactive (yellow marrow). The dosimetrically important tissues in the trabecular bone are the active marrow cells in the marrow cavities and the osteogenic cells on the surfaces of the bone trabeculae.

In this paper, a three-dimensional model of electron transport in trabecular bone is presented. This model uses the chord length distribution measurements through trabecular cavities and bone trabeculae obtained by Darley and Beddoe (*54-56*). Absorbed fractions of energy for monoenergetic electron sources are calculated using the EGS4/PRESTA Monte Carlo transport code (*9-11*). A comparison of dosimetric results obtained via one-dimensional transport and three-dimensional transport is also presented.

Previous Dosimetric Models of Trabecular Bone

Studies at the University of Leeds

The foundation of all trabecular bone dosimetry starts with the work of F. W. Spiers and his students at The University of Leeds between 1949 and 1989 (*54, 56-68*). From this research group, three major dissertations on bone dosimetry were published: one by Darley in 1972 (*56*), one by Whitwell in 1975 (*67*), and one by Beddoe in 1976 (*54*). Spiers determined through his research that the microstructure of trabecular bone could not be described using simple geometrical shapes. Instead, he used frequency distributions of linear path lengths through trabeculae and marrow cavities as a quantitative description of the three-dimensional structure of this region of the skeleton

(69). For this purpose, Darley and Beddoe designed an optical bone scanner capable of automatically measuring bone and cavity space chord length distributions of thin sections of human trabecular bone *(54-56)*. Assuming a direction of alignment of the cavities, they derived corresponding omnidirectional chord length distributions. Figure 3.2 A and B give the probability density function of a given chord length for trabecular cavities and bone trabeculae, respectively, for two bone sites: the parietal bone and the lumbar vertebra. A total of seven bone sites were measured including the cervical vertebra, the lumbar vertebra, the femur head, the femur neck, the iliac crest, the parietal bone, and the rib bone (Table 3.1). The chord lengths distribution data for all seven trabecular bone sites are given in Appendix C. Whitwell used the experimentally measured omnidirectional chord length distributions along with range-energy relationships to calculate dose conversion factors for seven radionuclides of interest in health physics (^{14}C, ^{18}F, ^{22}Na, ^{32}P, ^{45}Ca, ^{90}Sr, ^{90}Y) *(67, 68)*. In her study, only bone-and surface-seeking radionuclides were considered, and only the marrow and endosteum were chosen as target regions.

MIRD Pamphlet No. 11

The work of Whitwell focused on radionuclides of interest for radiation protection and therefore nuclear medicine dosimetry was not of primary importance. In 1974, Snyder et al. converted the skeletal-averaged dose conversion factors for given radionuclides to monoenergetic specific absorbed fractions using the average beta-particle energy of each radionuclide considered by Whitwell *(70)*. Using these specific absorbed fractions, trabecular bone S values were tabulated as part of MIRD Pamphlet No. 11 *(5)*.

Additionally, Whitwell had not considered explicitly the marrow as a source region, which is generally not relevant in health physics. Consequently, Snyder used conservation of energy and the uniform isotropic model, or reciprocity relationship, in order to obtain S values for the marrow as a source. However, this last model is only valid in a homogeneous medium (*7, 71*). Despite these extensive limitations, S values were tabulated as part of MIRD Pamphlet No. 11 (*5*) using this methodology.

ICRP Publication 30

In 1979, for bone radiation protection purposes, the ICRP published its Report 30 (*72*) which recommended absorbed fractions of energy for monoenergetic electrons. For monoenergetic electrons originating in the bone volume, a single value of absorbed fraction is recommended. For monoenergetic electrons originating on the bone surface, one absorbed fraction for low-energy beta particles (average beta energy less than 0.2 MeV), and one for high-energy beta particles (average beta energy greater than 0.2 MeV) is recommended. These absorbed fractions values are based on the dose conversion factors from Whitwell (*67, 68*). Subsequently, these relatively energy-independent absorbed fractions of energy were implemented in the MIRDOSE2 program (*73*) for use in nuclear medicine dosimetry. In this same computer program, the self-absorbed fraction to the marrow was assumed to be unity as suggested in Part 3 of the ICRP Publication 30 (*72*).

Eckerman model

In 1985, Eckerman (*74*) presented new absorbed fraction calculations based on the chord length distributions measured by Darley and Beddoe (*54-56*). Using Whitwell's approach of sampling of chord length distributions and using an electron range-energy relationship, he derived absorbed fractions of energy for the seven trabecular bone sites. These calculations were primarily intended to be used in radiation protection for photon sources within the ORNL mathematical phantoms (*18*) through the construction of photon fluence-to-dose conversion factors (*74*). In 1994, S values derived from these calculations were implemented in the MIRDOSE3 program to be used in nuclear medicine dosimetry (*73*).

Samaratunga Bone Model:

In 1995, Samaratunga et al. developed a more elaborate trabecular bone dosimetric model designed specifically to calculate the dose to skeletal metastases from the surface seeker ^{186}Re (*75*). They first measured chord length distributions of cavities and bone trabeculae on 25 samples from skeletal metastases. Bone trabeculae were then represented by ellipsoids located in an infinite marrow-tissue medium. Finally, the transport of electrons was simulated in a three-dimensional geometry using the Monte Carlo electron transport code EGS4. Even though the procedure was very sophisticated, the model developed by Samaratunga is intended for transport of electrons in trabecular bone metastases, and is therefore not applicable for Reference Man tabulations.

Materials and Methods

The chord length distributions measured by Spiers and his students at The University of Leeds represents the most complete information assembled to date on the microstructure of adult trabecular bone (*54-56*). While elegant in their design, the one-dimensional computational models of Spiers (*68*) and Eckerman (*74*) are based upon the assumptions that (a) particle trajectories are linear through both the bone matrix of the trabeculae and the marrow cavities such that a given chord length explicitly represents the particle path (no angular scatter); (b) energy loss within these structures can be treated under the continuous slowing-down approximation; and (c) the transport of energy by delta-rays and bremsstrahlung photons can be ignored. The computational model presented here attempts to account for each of these mechanisms by performing a three-dimensional transport of electrons using the EGS4/PRESTA radiation transport code (*9, 10*). The base input data for the model, however, are the same chord length distributions measured by the research group of Spiers (*54-56*).

Transport model

Due to the complex geometry of trabecular bone, a fixed geometric dosimetric model, such as the one adopted by the MIRD Committee for whole organ dosimetry cannot be easily constructed. Therefore, the model presented here is to be considered a transport model in that it randomly creates the trabecular bone regions, and not their true three-dimensional appearance, as the electron is transported. This process simulates the random mixture of marrow cavities and bone trabeculae seen by a particle traversing trabecular bone.

The chord length distributions measured by the group of Spiers (*54-56, 67*), represent the distribution of distances that one would see if crossing trabecular bone in many directions. If one considers an electron travelling in trabecular bone, the chord length distributions can be thought as the distribution of distances between entry and exit points of a given trabecular bone region. This concept is illustrated in Figure 3.3, where an electron and one of his delta-rays are shown. In this figure, the distances d_T and d_{MC} denote distances between entry and exit points of the bone trabeculae (T) and the marrow cavities (MC), respectively[1]. The chord length distributions can therefore be used to limit the travel of an electron in a given trabecular bone region by assuming the distance between the points of entry and exit of a given region to be equal to the sampled chord length for this region. By randomly sampling many chord lengths, and by considering many electrons, the average transport behavior of electrons in trabecular bone is thus realized.

Figure 3.4 A illustrates how the transport of the electron in a given trabecular bone region (trabeculae or marrow cavity) is limited using a sampled chord length (d_T or d_{MC}). The electron first enters a trabecula or marrow cavity at point I_0. At this point, a chord length d_T or d_{MC} is randomly selected, thus limiting the point of exit I_1 of the electron to be at a distance d_T or d_{MC} from I_0. This exit point is therefore located on a sphere centered on I_0, and of radius d_T or d_{MC}. In order to handle any possible backscatter, the sphere is further limited by a plane at I_0 perpendicular to the direction of travel U at the point of entry. This defines a hemisphere as the surface delimiting all possible points of exit I_1 of the electron. Thus, when entering a new region, the electron's distance of travel between two regions (straight-line distance) is limited; however, within a given region, the electron is allowed to travel in three dimensions. Consequently, one can have

a total electron path length traveled in a given region greater than d_T or d_{MC}, the distance physically separating the two different trabecular bone regions.

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[1] In the sample preparation procedures of Spiers and colleagues, all marrow tissues including endosteum were removed prior to optical scanning. Consequently, we make a distinction here between (1) the marrow cavity (the volume between bone trabeculae and its constituent endosteal layers), and (2) the marrow space (volume interior to both the bone trabeculae and endosteum).

Chord length distributions are available only for the marrow cavities and for the bone trabeculae. In order to consider the endosteum in the electron transport model, the only data available is a reference thickness of 10-μm as suggested by the ICRP (*76*). It is also possible to consider that the angle θ at which an electron enters any endosteal region can be randomly chosen between 0 and 90°. Therefore, for any electron entering an endosteal region, one can randomly derive a chord d_E through the endosteum according to the following equation:

$$d_E = (10\,\mu\text{m})\sec(\theta). \qquad \text{Eq. 3.1}$$

As noted earlier, this derived chord length through the endosteum was inclusive to the marrow cavity chord lengths measured by Spiers. Therefore, for any sampled marrow cavity chord length d_{MC}, one needs to derive two endosteal chords d_{E1} and d_{E2}, and a marrow space chord d_{MS} such that:

$$d_{MC} = d_{E1} + d_{MS} + d_{E2}. \qquad \text{Eq. 3.2}$$

This last equation limits the endosteal chord length such that:

$$\begin{aligned} d_{MS} &= 0, \text{ and} \\ d_{MC} &= d_{E1} + d_{E2}, \end{aligned} \qquad \text{Eq. 3.3}$$

which corresponds to a chord measurement through only the near and far endosteal layers. This notion of endosteal chord lengths and marrow space chord lengths is demonstrated in Figure 3.4 B. In this figure, two marrow cavity chords are shown: one defining three chords (e.g., Equation 3.2) and the other defining two chords (e.g., Equation 3.3). In summary, for each sampled marrow cavity chord length d_{MC}, one first calculates two endosteal chords according to Equation 3.1, by using the two random entry angles θ_1 and θ_2. Then if $d_{E1} + d_{E2} \geq d_{MC}$,

$$d_{E1} = d_{E2} = \frac{d_{MC}}{2}, \text{ and}$$
$$d_{MS} = 0. \qquad \text{Eq. 3.4}$$

Otherwise if $d_{E1} + d_{E2} \leq d_{MC}$,

$$d_{E1} = (10\,\mu\text{m})\sec(\theta_1),$$
$$d_{E2} = (10\,\mu\text{m})\sec(\theta_2), \text{ and} \qquad \text{Eq. 3.5}$$
$$d_{MS} = d_{MC} - (d_{E1} + d_{E2}).$$

Each derived chord lengths are then used to limit the electron transport using a hemispherical transport region as shown in Figure 3.4 C and D.

To initiate the transport of an electron within a given trabecular bone region, the starting region has to be first considered. If a particle originates within the marrow cavity or the bone trabeculae, the distance to the nearest boundary follows a distribution different from the chord length distributions measured by Spiers. There are three types of distributions of chord lengths in convex bodies of interest in radiation dosimetry *(77-79)*. The first is the mean-free-path randomness or μ-randomness, where a chord is defined by a point in space and a given direction. The second is the interior randomness or I-randomness, where a chord is defined by a point interior of the convex body and a given direction. The third is the surface radiator randomness or S-randomness, where a chord is defined by a point on the surface of the convex body and a given direction. To generate chord distributions, the directions and starting points are selected from independent uniform distributions. Figure 3.5 summarizes the three different chord length distributions. For our purposes, the I-random chord distribution is of interest when the particle originates within a given region. The measurements of chord length distributions in trabecular bone performed by Spiers were made under the conditions of μ-randomness. To derive an I-random chord distribution from a μ-random chord distribution, the following relationship can be used:

$$f_I(d) = \frac{d}{\langle d \rangle_\mu} f_\mu(d), \qquad \text{Eq. 3.6}$$

where $f_I(d)$ and $f_\mu(d)$ are the probability density functions for chord lengths under I- and μ-randomness, respectively, and $\langle d \rangle_\mu$ is the average chord length under μ-randomness (*77*). Thus, using this derived I-random chord distribution, an interior chord length d_I can be derived for both trabecular cavities and bone trabeculae. After choosing an interior chord d_I, a starting internal distance d_0 between 0 and d_I is randomly selected. This selected distance thus limits the distance traveled by the electron in the initial source region. The direction of travel of the source particle is taken as the +Z direction. After traveling this distance of d_0, the electron enters a new region, and this region is created as described earlier, by using its direction of travel, and the μ-random chord length distribution. The Figure 3.6 shows the geometry that is presented to the electron to simulate its transport in trabecular bone. In the same figure, a backscattered electron and the creation of a delta-ray are also shown.

This method of determination of the initial region for the transport of electrons in trabecular bone can be applied for bone volume sources, where the bone trabeculae is the starting region, and for marrow sources, where the marrow space is the starting region. For surface sources, where the endosteum is the source region, no chord length distributions are available, and only the reference thickness of the endosteal region is available. In this case, the starting particle is randomly selected between two planes separated by an average thickness of 10 μm, and its initial direction is randomly chosen. The only concern here could be the curvature of the surfaces of the endosteum which is taken as infinite in the case of two parallel planes. However, due to the small thickness of the two planes, this is only of concern for very low energy electrons since higher energy electrons will exit very quickly from the source endosteal region. Once the electron escapes the Z=10 μm plane, a new trabeculae bone region hemisphere is randomly selected. If it escapes the Z=0 μm plane, a new marrow cavity region is selected. Figure 3.7 shows a diagram of the geometry presented to the electron in the case of an endosteum electron source within the trabecular bone.

The electron transport model so constructed represents a logical extension to the one-dimensional electron transport model of Eckerman (*74*) and Whitwell (*67, 68*). It allows the electron to travel in any direction, while simulating the correct distribution of chord lengths that would be seen by an electron travelling in trabecular bone. Furthermore, the model can be implemented within a Monte Carlo electron transport code, thus allowing for electron backscatter, bremsstrahlung photons, and delta-rays to be simulated. The main limitation of this transport model is that it utilizes the limited information embedded in the measured omnidirectional chord length distributions of Spiers; the true three-dimensional microstructure of trabecular bone is not fully modeled.

Consideration of percent active marrow

An additional feature of the present model is the consideration of marrow space cellularity within different skeletal regions. The cellularity factor (CF) is defined as the fractional mass of marrow space occupied by active (red) marrow, the remainder being composed of inactive (yellow) marrow (*80*). At birth, 100% of all marrow is active. As one ages, marrow spaces within the appendicular skeleton, and to some extent the axial skeleton, accumulate adipose tissue thus transitioning to yellow marrow. Standard values of age-specific cellularity factors were recently published in ICRP Publication 70 (*25*), a revision to the skeletal chapter of the Reference Man report (*39*). For an adult of age 40, ICRP Publication 70 assigns a CF of 0.7 for the vertebrae (e.g., cervical and lumbar) and the ribs, 0.48 for the illiac crest, 0.38 for the parietal bone. Since a CF for the femur head and neck was not explicitly tabulated, the CF for these sites was assumed to be the same as that for the iliac crest (only the CF factor for the upper half of the femur is tabulated, and thus this value incorporates the marrow composition within the proximal half of the femoral shaft).

The elemental composition and density of pure red and yellow marrow has been defined in ICRU Report 46 (*81*) and is reproduced in the first three columns of Table 3.2. Given this data and the four defined values of marrow cellularity, one may determine unique elemental compositions and mass densities for the marrow space within bone group i as:

$$\rho_{i,\mathrm{MS}} = \mathrm{CF_i} \cdot \rho_{\mathrm{RM}} + \left(1 - \mathrm{CF_i}\right) \cdot \rho_{\mathrm{YM}}, \text{ and} \qquad \text{Eq. 3.7}$$

$$\left(\%\mathrm{mass}_{\,i}\right)_{\mathrm{MS}} = \mathrm{CF_i} \cdot \left(\%\mathrm{mass}_{\,i}\right)_{\mathrm{RM}} + \left(1 - \mathrm{CF_i}\right) \cdot \left(\%\mathrm{mass}_{\,i}\right)_{\mathrm{YM}} \qquad \text{Eq. 3.8}$$

These data are given in columns 4 to 7 of Table 3.2. Finally, the endosteal layers within the model are assigned an elemental composition defined in ICRU Report 44 (*82*) for the average adult male soft tissue (column 8). The composition of the trabecular regions (column 9) was taken as that defined in ICRU Report 46 for adult cortical bone (*81*).

Transport parameters

The EGS4 Monte Carlo transport code (*9*) along with the PRESTA algorithm (*10*) was used for all simulations of electron transport. The electron cut-off total energy (ECUT and AE) used was 512 keV for initial kinetic electron energies less than 50 keV and 521 keV for initial kinetic electron energy greater than 50 keV. The cut-off energy for photons (PCUT and PE) used was 0.001 keV. The maximum percent energy loss per step due to continuous slowing down (ESTEPE) was chosen as 2%. Bremsstrahlung photons were followed up to a distance not to exceed 5 cm from the initial source point. A total of 100,000 histories were simulated per particle energy (10 runs of 10,000 histories). An average absorbed fraction and its corresponding standard deviation were then derived for all target regions.

Results and Discussion

Electron absorbed fractions of energy are calculated for the seven trabecular bone sites measured by Darley and Beddoe (*54-56*). Three sources and three target regions are considered: trabecular bone volume (TBV), trabecular marrow space (TMS), and trabecular bone endosteum (TBE). Twelve energies are considered between 10 keV and 4 MeV. The results are given in Appendix D in Table D.1 for the trabecular marrow space as a source, Table D.2 for the trabecular bone endosteum as a source, and Table D.3 for the trabecular bone volume as a source. The calculated coefficient of variations (CV) are less than ~0.5% when the source and the target region are equal. When the source and target are different, the CV are less than ~5%. An exception is at very low energies (10 keV and 15 keV) for non-adjacent source-target regions combinations (TBV and TMS), where some values of the CV are as high as 50%.

The marrow space as the radiation target

The absorbed fraction to the marrow space for monoenergetic electron sources emitted within the marrow space is shown in Figure 3.8 A for three of the seven skeletal sites for which chord length distributions are available. At the lowest electron energy considered (10 keV), essentially all of the electron energy is absorbed within the target region. At increasingly higher energies, the absorbed fraction declines from unity as electrons begin to penetrate the endosteal layer of the source marrow space and the adjacent trabeculae. At approximately 500 keV to 1 MeV, electrons are able to penetrate to the marrow spaces of adjacent cavities, thus resulting in a leveling-off of the absorbed fraction with further increases in emission energy.

The influence of the regional microstructure of trabecular bone is evident in Figure 3.8 A. The absorbed fraction to the parietal bone, with its substantially smaller marrow cavities, is shown to fall more rapidly with electron energy than in the cervical vertebrae or in the rib bone. ICRP Publication 30 (*72*) did not explicitly consider marrow as a source region, although one may assume an energy-independent absorbed fraction of 1.0 for this case. Clearly, this assumption grossly overestimates the radiation dose to this tissue region at moderate to high electron energies.

Absorbed fractions to the marrow space for trabecular bone endosteum sources are shown in Figure 3.8 B. ICRP Publication 30 (*72*) assumes an energy-independent value of 0.5 in the assumption that only 50% of the emissions on the bone surfaces emit electrons into the marrow space where they deposit their full energy. In the current model, electrons representing "surface-seekers" are more properly emitted within the trabecular endosteum volume where they must first exit the 10-μm layer prior to reaching the marrow space; thus the absorbed fraction starts close to zero at low energies and rises rapidly as a greater fraction of the initial electron energy is deposited within the first marrow cavity. At higher energies, subsequent trabeculae must be crossed before any additional energy deposition to marrow can occur and thus the absorbed fraction increases less rapidly with increasing initial energy. The variation of absorbed fraction with particle energy in the parietal bone is markedly different from that within the vertebral regions due to its larger bone trabeculae and smaller marrow cavities (see Table 3.1).

Figure 3.8 C shows the corresponding absorbed fractions to the marrow space for electron sources uniformly distributed within the bone volume of the trabeculae. As with the trabecular bone endosteum sources, the absorbed fraction begins at zero at low energies and increases to a limiting value at high electron energies. In this case, however, electrons must pass through both the trabeculae and the endosteal layer prior to reaching the first marrow cavity. Consequently, the rise in absorbed fraction for bone volume sources occurs over a broader energy range than for trabecular bone endosteum sources. The ICRP methodology (*72*) assumes an energy-independent value of 0.35. This value is shown to overestimate energy absorption for low-energy electrons for all bone sites. At

higher electron energies, energy absorption in the marrow space is underestimated for vertebral and rib sources and overestimated for electron sources in the skull.

For a given skeletal site, Figure 3.8 A, B, and C indicate a convergence of the absorbed fraction to a single value at high energies, which is independent of the source region. This limiting value corresponds to the fractional track length in the target marrow cavity for a given bone site:

$$\phi(\mathrm{TMS} \leftarrow \mathrm{S}) = \frac{\langle d_{MC} \rangle_{\mu} - 2\langle d_E \rangle}{\langle d_{MC} \rangle_{\mu} + \alpha \langle d_T \rangle_{\mu}}, \qquad \text{Eq. 3.9}$$

where $\langle d_{MC} \rangle_{\mu}$ and $\langle d_T \rangle_{\mu}$ are the average chord lengths under μ-randomness for the marrow cavities (exclusive of its endosteal layers) and bone trabeculae, respectively, $\langle d_E \rangle$ is the average thickness of endosteum crossed (derived for each bone site from the transport code assuming a random entry angle of the electron into the endosteum), and α is the ratio of the range of electrons in marrow to that in bone tissue ($\alpha \approx 1.7$ using ICRU Report 46 (*81*) tabulated R_{CSDA} ranges). This limit of the absorbed fraction at high energies is verified in Table 3.3 where the absorbed fraction for 4 MeV electrons is compared to this calculated absorbed fraction limit.

The trabecular endosteum as the radiation target

The second radiation target to consider is the endosteal tissue layer of trabecular bone (TBE). Figure 3.9 A shows the variation of the absorbed fraction to the TBE region for marrow sources of electrons and for the same three skeletal regions discussed above. Depending on the bone trabeculae and marrow cavity average sizes, two different variations of the absorbed fraction with energy are observed. In the case of the parietal bone, where marrow cavity sizes are small and bone trabeculae are large (see Table 3.1), a rapid increase is first seen up to a maximum occurring at ~100 keV. Next, the absorbed fraction decreases slowly and levels off at a constant absorbed fraction for high electron energies. For the other trabecular bone regions, where the marrow cavities are much larger than the bone trabeculae, the absorbed fraction increases almost steadily in reaching a maximum value. These differences in the variation of the absorbed fractions with initial electron energy can be further investigated by looking at Figure 3.10. In this figure, the absorbed fraction of energy is partitioned into the various created TBE regions irradiated by electrons originating in the TMS in both the parietal bone (A) and the cervical vertebra (B). For the TBE directly adjacent to the TMS source (TBE #1), the absorbed fraction of energy in the parietal bone is seen to increase more rapidly with source particle energy than in the cervical vertebra. Consequently, the unique microstructure of the parietal bone leads to a dominance of the first TBE region (adjacent) in the total value of the absorbed fraction to the trabecular endosteum. In the case of the cervical, the decrease in the absorbed fraction to the first endosteal region for source energies greater than 200 keV is compensated by energy deposited in subsequent TBE regions, and the global absorbed fraction continues do increase with increasing source particle energy.). For a TMS source and a TBE target, ICRP Publication 30 (29) recommends that $\Phi(\mathrm{BS} \leftarrow \mathrm{RM}) = \Phi(\mathrm{RM} \leftarrow \mathrm{RM})/2$, therefore giving an energy-independent absorbed fraction of 0.02 to the TBE (assuming a TMS mass of 1,500 g and a TBE mass of 60 g (*39*)). This recommendation underestimates our calculated absorbed fractions at electron energies greater than ~170 keV for the rib, at energies greater than ~50 keV for the cervical vertebra, and at energies greater than ~20 keV for the parietal bone.

For trabecular bone endosteum (TBE) sources, the model predicts absorbed fractions to trabecular endosteum as being relatively independent of the skeletal microstructure (see Figure 3.9 B). At 10 keV, an absorbed fraction of ~0.9 is indicated due to the small thickness of the endosteum. The value drops rapidly to reach a plateau at energies greater than about 1.0 MeV. The methodology of ICRP Publication 30 (*72*) recommends a discontinuous drop in the absorbed fraction from 0.25 at energies less than 200 keV to a value of 0.025 at greater energies. For electron energies 50 keV or less, and 200 keV and more, the ICRP 30 method underestimates the energy deposition to trabecular endosteum.

Figure 3.9 C gives the absorbed fraction results for the absorbed fraction to trabecular endosteum (TBE) for bone volume sources (TBV). As with the marrow space (TMS) as the source region, there are two trends of the absorbed fraction with the electron energy depending on the relative sizes of the bone trabeculae and marrow spaces. For the parietal bone with its larger bone trabeculae, the absorbed fraction follows a steady increase until about 1.0 MeV where a limiting value is reached. In other skeletal regions, where smaller bone trabeculae and larger marrow cavities are found, the absorbed fraction of energy follows a trend identical to that shown for the parietal bone when the marrow space was the source region (Figure 3.9 A). For a TBV source and a TBE target, ICRP Publication 30 (*72*) recommends an energy-independent absorbed fraction of 0.025 to the TBE. This recommendation underestimates our calculated absorbed fractions for energies greater than ~30 to 50 keV.

As it was noticed for the TMS as the target region and for all three source regions, the resulting absorbed fractions at high initial energies are independent of the source region. This limiting value of the absorbed fraction corresponds to the fractional track length in the endosteal cavity for the given bone site:

$$\phi(\mathrm{TBE} \leftarrow \mathrm{S}) = \frac{2\langle \mathrm{d_E} \rangle}{\langle \mathrm{d_{MC}} \rangle_\mu + \alpha \langle \mathrm{d_T} \rangle_\mu}, \qquad \text{Eq. 3.10}$$

where $\langle \mathrm{d_{MC}} \rangle_\mu$, $\langle \mathrm{d_T} \rangle_\mu$, $\langle \mathrm{d_E} \rangle$, and α were defined previously. The factor of two added in the numerator of Equation 3.10 is to take into account the two regions of endosteum crossed when an electron enters and exits a marrow cavity. Similar to the TMS as the target region, the limits of the absorbed fractions at large energies for each bone site are verified in Table 3.3.

The bone trabeculae as the radiation target

The last radiation target that can be considered is the trabecular bone volume (TBV). Although this target is not of importance for radiation protection, there is some interest to consider it as a radiation target for the alleviation of bone pain using radionuclide therapy (*49*). Three graphs are presented in Figure 3.11, corresponding to the three possible trabecular bone sources: the TMS, the TBE, and the TBV. Variations observed in the absorbed fractions with initial electron energy are complimentary but inverted to those observed when the TMS was considered the target region (Figure 3.8). The highest absorbed fraction of energy is for the parietal bone since it represents the skeletal site with the largest bone trabeculae and the smallest marrow cavities.

As seen for the previous trabecular targets, the absorbed fraction to the TBV at high electron initial energies is independent of the source considered. This limit corresponds to the fractional track length in the bone trabeculae for the given bone site:

$$\phi(\mathrm{TBV} \leftarrow \mathrm{S}) = \frac{\langle d_T \rangle_\mu}{\langle d_{MC} \rangle_\mu + \alpha \langle d_T \rangle_\mu}, \qquad \text{Eq. 3.11}$$

where $\langle d_{MC} \rangle_\mu$, $\langle d_T \rangle_\mu$, and α were defined previously. These limits of the absorbed fraction at large energy for each trabecular bone sites are verified in Table 3.3.

Comparisons to a one-dimensional electron transport Model

A one-dimensional model of electron transport in trabecular bone was also constructed to compare absorbed fraction results from the three-dimensional model presented in this paper. Following the methodology employed in the three-dimensional model, chord lengths were sampled in all three regions of the trabecular bone to construct the one-dimensional geometry presented to the electron. The energy deposited in a given region was scored assuming a straight trajectory of the electron through all trabecular bone regions and using the range-energy relationship adopted by Whitwell and Eckerman (*67, 68, 74*). The range-energy relationship used was

$$R = A\,E^{m}, \qquad \text{Eq. 3.12}$$

where the values of m and A used in this research were derived using curve fits to the soft tissue composition from data given in ICRU Report 37 (*83*). Table 3.4 gives these calculated values of A and m. These values are given such that if E is in MeV, R will be in g cm^{-2}. The error on the curve fitting is less than 1% at all energies. For the bone tissue, the ratio of the range (cm) in tissue to that in bone is a constant over the energy-range of interest (1 keV to 5 MeV) and is equal to 1.7. Therefore, the energy-range relationship for bone was derived from that predicted in soft tissue using Equation 3.12.

Using this technique, absorbed fractions of energy were calculated for the same combinations of bone site, electron energy, source region, and target region considered in the three-dimensional transport model. A total of 100,000 particles were sampled per bone site, for each source region, and electron initial energy.

Figure 3.12 gives the comparison between the absorbed fractions of energy calculated using the three-dimensional and one-dimensional transport models. In this figure, the ratio of absorbed fractions from the three-dimensional and one-dimensional models, averaged over all seven bone sites, is plotted as a function of the initial electron energy. Various source and target combinations are considered as indicated in the legend. Globally, good agreement is seen between the two calculations. Differences are larger at low energies, up to 50%, but these discrepancies decrease as the electron initial energy increases (the maximum error at 4 MeV is 5%). This data agreement was expected since the same chord length distributions were taken as input in both models.

If one considers the absorbed fractions of energy calculated when the source and the target regions are identical (the black diamonds, triangles, and circles in Figure 3.12), one sees that there is a very good agreement, except when the source/target region is the TBE. In this case, the difference is first very small, then increases to a maximum of 14% at 200 keV. Results from the two models converge again at higher energies. These differences are attributed to differences in the physics of the transport: a three-dimensional Monte Carlo transport code vs. a one-dimensional calculation using a range-energy relationship for electrons.

The largest differences between models are seen when the source and the target are not adjacent regions, i.e. when the TMS and TBV are considered for source and target regions (gray diamond and circle in Figure 3.12). In this case, we see differences 30-50% and upward for energies less than 100 keV. Due to the possible variations in the range of the electrons modeled by the EGS4 Monte Carlo transport code (i.e., range straggling), we see low energy electrons reaching these non-adjacent regions using the three-dimensional model, while they do not in the one-dimensional model. Differences of ~10% are also seen for energies less than 100 keV when the source is the TBE and the target is the TMS or TBV (open diamond and circle in Figure 3.12). Finally, when one considers the TBE as a target, and the TMS and TBV as source regions (cross and plus signs in Figure 3.12), very good agreement is seen between the two transport methodologies.

Overall, the three-dimensional transport model of electron transport in trabecular bone is shown to be consistent with a simpler one-dimensional model of electron transport. The three-dimensional model is preferred due to the more precise simulation of the physics of the electron transport embedded within the EGS4-PRESTA code.

If one wants to compare the absorbed fractions from the present model with those used in the MIRDOSE3 program (*73*), the only publication available is a symposium paper published by Eckerman in 1985 (*74*). In this paper, a table of absorbed fractions is given for only two bone sites (the parietal bone and the lumbar vertebrae), for two sources (the trabecular bone and marrow), and two targets, (the bone surface and the bone marrow). Since this model is a one-dimensional model, one can compare results with the one-dimensional model of this paper. In the case of the bone surface (i.e., endosteum) as a target, large differences are seen between the two methods (ratios of 1.50 at electron energies greater than 1 MeV). Since limited descriptions were given in the 1985 symposium paper as to how the bone surface was considered as a target region, we cannot comment further on these differences. In the case of the marrow as a target, it seems that the author considers the full marrow cavity as the target region and not the marrow space as defined here. This distinction is evident when the absorbed fractions to marrow of reference *74* are compared to the sum of the absorbed fractions to the TMS and the TBE for a TMS source as given by the one-dimensional model of this paper. In such a comparison, good agreement, ranging from 0 to 15%, is seen.

Summary and Conclusions

A new model of electron transport in trabecular bone has been presented. It is based on the chord length distributions measured by Spiers (*54-56*), and uses the Monte Carlo transport code EGS4-PRESTA (*9-11*). This model is a logical three-dimensional extension of currently used one-dimensional transport models of electrons in trabecular bone. This extension allows for the treatment of backscattered electrons, delta rays, and bremsstrahlung photons not previously considered.

Using this model, absorbed fractions of energy are tabulated for seven trabecular bone sites, twelve energies, and all source and target combinations using the three simulated trabecular bone regions: TMS, TBE, and TBV. These calculated absorbed fractions will allow more precise dosimetry to be performed in adult trabecular bone. One target of interest that was not considered in this model is the trabecular active marrow (TAM). The TAM is a part of the TMS as defined by the cellularity factor (CF). For the trabecular bone site j, the CF is given as:

$$CF_j = \frac{m_{TAM,j}}{m_{TMS,j}}, \qquad \text{Eq. 3.13}$$

where m_j represents the mass in bone site j of the TAM or the TMS. If one assumes that for a given source region, the electron energy is uniformly deposited across the TMS, one can calculate the absorbed fraction to the TAM for the bone site j by using the ratio of volumes occupied by the TAM within the TMS:

$$\phi_j(TAM \leftarrow S) = \frac{V_{TAM,j}}{V_{TMS,j}} \phi_j(TMS \leftarrow S). \qquad \text{Eq. 3.14}$$

Since the density of the marrow space and red marrow are very close, one can simplify Equation 3.14 by using the CF:

$$\phi_j(TAM \leftarrow S) = CF_j \, \phi_j(TMS \leftarrow S). \qquad \text{Eq. 3.15}$$

This equation is valid only in the case of a source located in the TMS, TBE, or TBV. It is not possible to calculate the absorbed fractions of energy for a source located in the TAM since the location of the TAM within the TMS is not currently known. It is therefore advisable to use the TMS as the source region until such information becomes available.

Given that the chord length distributions of Spiers and colleagues represents the most complete description of trabecular bone microstructure published to date, the three-dimensional model presented here which utilizes this input data cannot be significantly improved upon. The model represents a three-dimensional transport model and is not to be interpreted as a geometric_model of trabecular microstructures. Future improvements in bone dosimetry models await more realistic characterizations of trabecular bone as suggested by Jokisch et al. using direct imaging techniques such as NMR microscopy (*84*). Nevertheless, the values of absorbed fraction given here represent a substantial improvement over the relatively energy-independent values of ICRP Publication 30 (*72*) and moderate improvements to values produced by one-dimensional transport methods.

Table 3.1: Mean trabeculae and cavity chord lengths for seven trabecular bone sites in a 44-year-old male *(54-56)*.

Bone site	**Mean trabeculae chord length (μm)**	**Mean marrow Cavity chord length (μm)**	**Ratio of trabecular and marrow mean chord lengths**
Parietal bone	511	389	1.315
Cervical vertebrae	279	910	0.307
Lumbar vertebrae	246	1234	0.199
Rib bone	266	1706	0.156
Iliac crest	242	904	0.268
Femur head	232	1157	0.200
Femur neck	314	1655	0.190

Table 3.2: Elemental composition of regions within the transport model (percentage by mass) derived from ICRU Reports 44 and 46 (*81, 82*)

Element	**Red Marrow**	**Yellow Marrow**	**Medium 1**[*]	**Medium 2**[†]	**Medium 3**[‡]	**Endosteum**	**Trabeculae**
H	10.50	11.50	10.80	11.02	11.12	10.50	3.40
C	41.40	64.40	48.30	53.36	55.66	25.60	15.50
N	3.40	0.70	2.59	2.00	1.73	2.70	4.20
O	43.90	23.10	37.66	33.10	31.00	60.20	43.50
Na	-	0.10	0.03	0.05	0.06	0.10	0.10
Mg	-	-	-	-	-	-	0.20
P	0.10	-	0.07	0.05	0.04	0.20	10.30
S	0.20	0.10	0.17	0.15	0.14	0.30	0.30
Cl	0.20	0.10	0.17	0.15	0.14	0.20	-
K	0.20	-	0.14	0.10	0.08	0.20	-
Ca	-	-	-	-	-	-	22.50
Fe	0.10	-	0.07	0.05	0.04	-	-
Mass Density ($g\ cm^{-3}$)	1.030	0.980	1.015	1.004	0.999	1.030	1.920

[*] Medium 1 includes the cervical vertebrae, lumbar vertebrae, and the ribs for which CF = 0.7

[†] Medium 2 includes the illiac crest and the femur head and neck for which CF = 0.48

[‡] Medium 3 includes the parietal bone for which CF = 0.38

Table 3.3: Limits of absorbed fractions of energy calculated using average chords through the TMS, TBE, and the TBV. These theoretical calculated averages are compared with the Monte Carlo calculated averages at 4 MeV for all source and target combinations.

	Cervical	Femur Head	Femur Neck	Iliac Crest	Lumbar	Parietal	Rib
AVERAGE CHORDS LENGTHS (μm)							
Trabeculae	279	232	314	242	246	511	266
Marrow cavities	910	1157	1655	904	1234	389	1706
Marrow space	839	1082	1577	832	1160	329	1626
Endosteum	36	38	39	36	37	30	39
Limits of Absorbed Fraction at High Energy							
T=TMS	6.1E-01	7.0E-01	7.2E-01	6.3E-01	7.0E-01	2.6E-01	7.5E-01
T=TBE	5.2E-02	4.9E-02	3.6E-02	5.5E-02	4.5E-02	4.8E-02	3.6E-02
T=TBV	3.4E-01	2.5E-01	2.4E-01	3.1E-01	2.5E-01	6.9E-01	2.1E-01
Ratios of AF at 4 MeV to the limit AF calculated for T=TMS							
S=TMS	1.00	1.00	1.00	1.00	1.00	1.01	1.00
S=TBE	0.95	0.96	0.97	0.98	0.96	0.97	0.94
S=TBV	0.96	0.96	0.95	0.96	0.95	0.97	0.93
Ratios of AF at 4 MeV to the limit AF calculated for T=TMS							
S=TMS	0.99	0.98	0.99	0.99	0.99	0.99	0.99
S=TBE	0.97	0.99	1.00	0.99	1.00	0.98	0.99
S=TBV	0.98	0.98	0.98	0.97	0.98	0.98	0.97
Ratios of AF at 4 MeV to the limit AF calculated for T=TMS							
S=TMS	0.98	0.98	0.97	0.99	0.98	0.97	0.97
S=TBE	0.96	0.98	0.99	0.98	0.98	0.97	0.97
S=TBV	0.99	1.00	1.02	0.98	1.00	0.99	1.03

Table 3.4: Coefficients used to calculate the CSDA range for electrons in soft tissue medium. They were derived from data given in ICRU Report 37 (*83*), and the error on the interpolation in all cases is less than 1%. In order to use these coefficients, the energy should be given in MeV, and the range is given in g cm^{-2}.

Energy Range (MeV)	A (g cm^{-2})	m
$0.00 < E \leq 0.05$	0.86341	1.7682
$0.05 < E \leq 0.10$	0.76684	1.7285
$0.10 < E \leq 0.30$	0.59607	1.6138
$0.30 < E \leq 0.60$	0.47275	1.4270
$0.60 < E \leq 2.00$	0.43234	1.1990
$2.00 < E \leq 5.00$	0.49150	1.0233

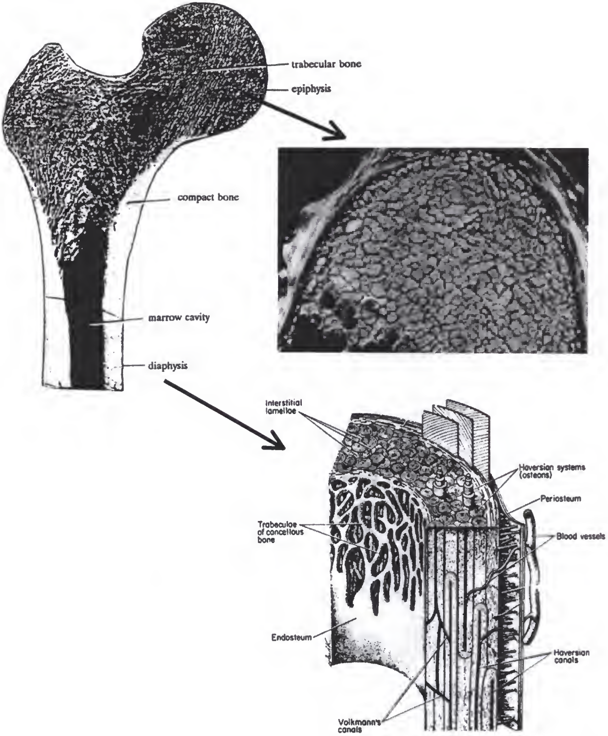
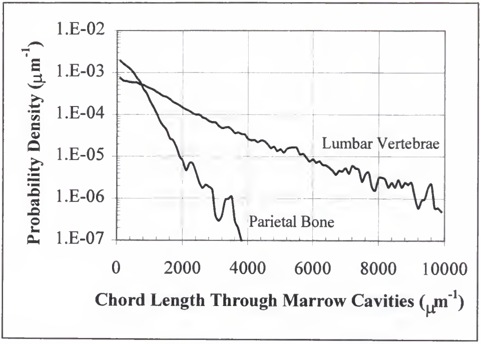
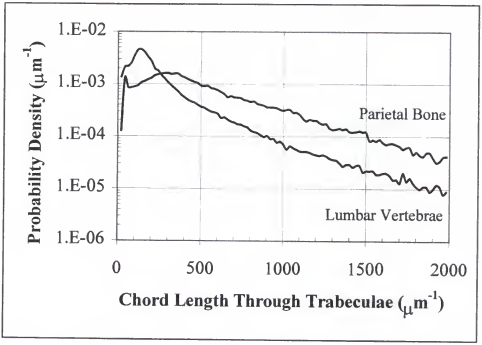


Figure 3.1: Diagram of the upper half of a femur showing the trabecular bone regions in the femur head (NMR image) and neck, and the cortical bone regions in the diaphysis (lower diagram).

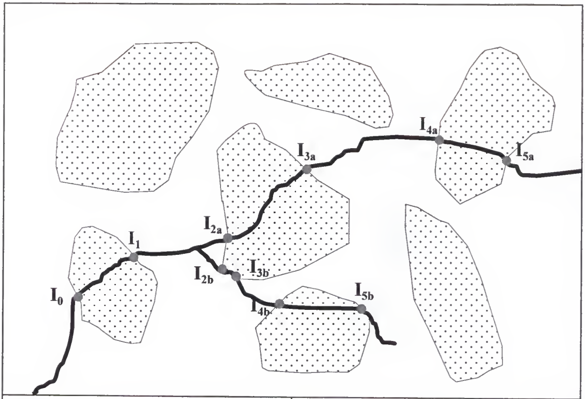


(A)



(B)

Figure 3.2: Chord length distributions for the parietal bone and for the lumbar vertebrae through (A) marrow cavities and (B) bone trabeculae *(54-56)*.



Distribution of distances between points of entry and points of exit for the marrow cavities	Distribution of distances between points of entry and points of exit for the bone trabeculae
$d_{MC\_1} = \text{distance}(I_0,I_1)$	$d_{T\_1}=\text{distance}(I_1,I_{2a})$
$d_{MC\_2} = \text{distance}(I_{2a},I_{3a})$	$d_{T\_2}=\text{distance}(I_1,I_{2b})$
$d_{MC\_3} = \text{distance}(I_{4a},I_{5a})$	$d_{T\_3}=\text{distance}(I_{3a},I_{4a})$
$d_{MC\_4} = \text{distance}(I_{4b},I_{5b})$	$d_{T\_4}=\text{distance}(I_{3b},I_{4b})$

Figure 3.3: Diagram showing an electron passing through a region of trabecular bone. The marrow cavities are represented as textured areas. The entry and exit points of any new trabecular bone region that the electron encounters along its path are shown. The distribution of distances between these points for the cavities and the bone trabeculae represent the measured chord length distributions obtained by Spiers and colleagues *(54-56)*.

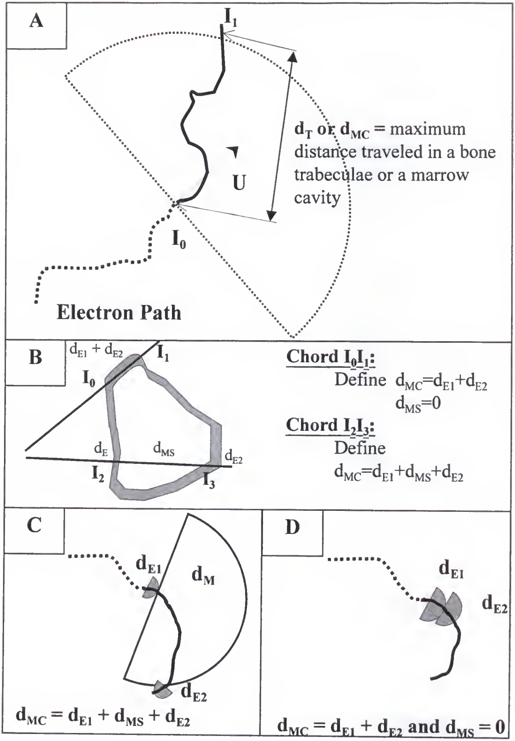

A
I_1
d_T or d_{MC} = maximum distance traveled in a bone trabeculae or a marrow cavity
U
I_0
Electron Path
B
$d_{E1} + d_{E2}$
I_1
I_0
d_E
d_{MS}
d_{E2}
I_2
I_3
Chord I_0I_1:
Define $d_{MC}=d_{E1}+d_{E2}$
$d_{MS}=0$
Chord I_2I_3:
Define
$d_{MC}=d_{E1}+d_{MS}+d_{E2}$
C
d_{E1}
d_M
d_{E2}
$d_{MC} = d_{E1} + d_{MS} + d_{E2}$
D
d_{E1}
d_{E2}
$d_{MC} = d_{E1} + d_{E2}$ and $d_{MS} = 0$

Figure 3.4: Diagram illustrating the three-dimensional electron transport model. Part (A) shows how a sample chord length is used to limit the electron transport by creation of a hemisphere. Part (B) shows the derivation of a chord through the near and far endosteal layers (dE1 and dE2) and through the marrow space (dMS) from a marrow cavity chord length dMC. Part (C) and (D) shows how the derived chords dE1, dE2, and dMS are used to limit the extent of electron transport.

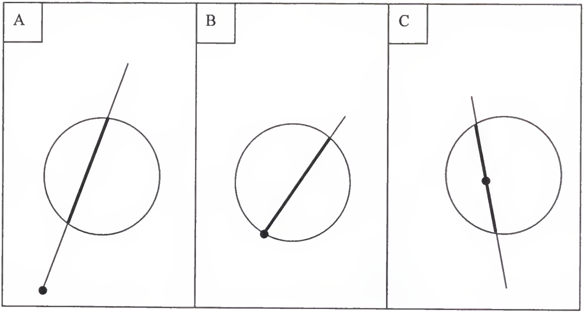


Figure 3.5: Illustration of the three different types of chords within a convex body of interest in radiation dosimetry: (A) μ-randomness, (B) S-randomness, and (C) I-randomness

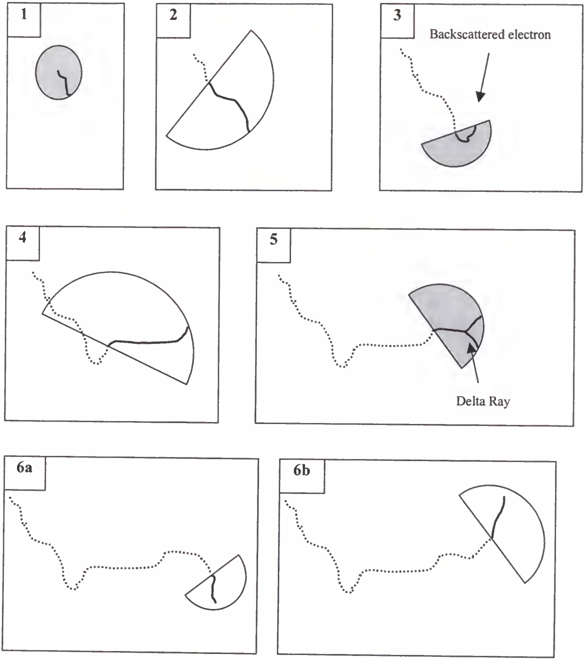


Figure 3.6: Model of electron transport in trabecular bone. Shaded areas are the bone trabeculae regions, and white areas are the marrow space regions. The endosteal hemispheres are not shown in this diagram due to their relatively small size. The different panels represent sequential frames showing the modeling of the path of an electron through trabecular bone. In this diagram, a backscattered electron is represented in panel 3 and a delta-ray in panels 5 and 6.

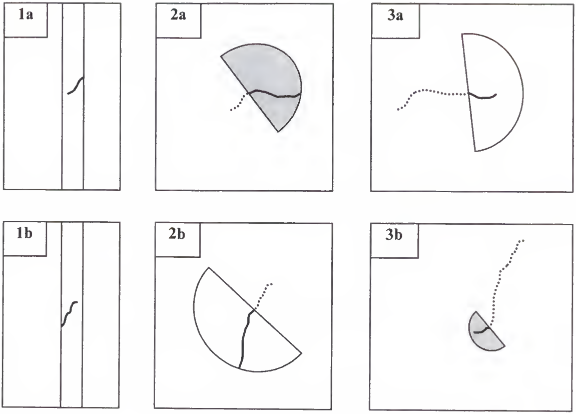
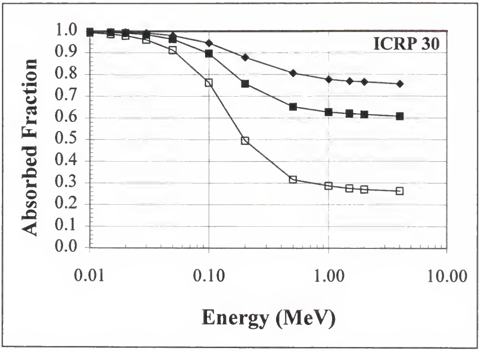
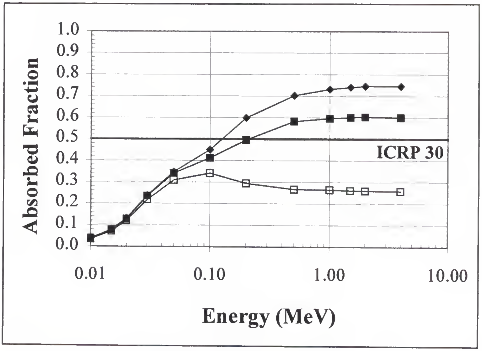


Figure 3.7: Model of the electron transport in trabecular bone where the endosteum is the source region. Shaded areas are the bone trabeculae regions and white areas are the marrow cavity regions. The panel series 1a, 2a, and 3a show an electron exiting the endosteal layer towards the bone trabeculae (Z=10 μm), while the panel series 1b, 2b, and 3b show an electron exiting the endosteal layer bordering the marrow space (Z=0 μm). In this diagram, the subsequent endosteal hemispheres are not shown due to their small relative size.

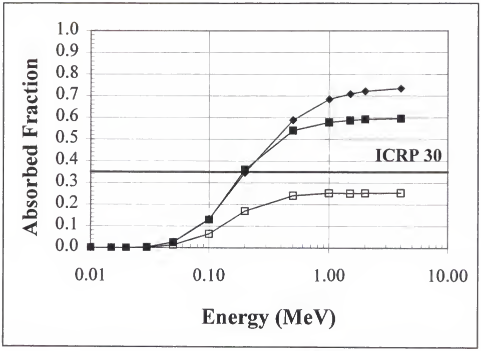


(A): S = TMS, T = TMS



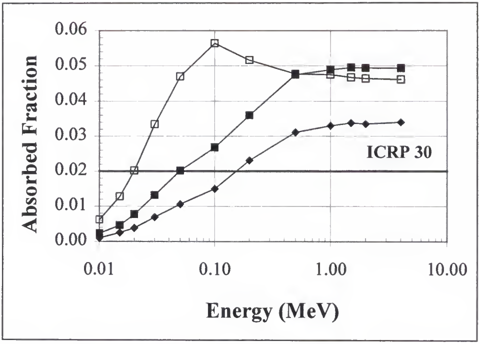
(B): S = TBE, T = TMS

Figure 3.8: Absorbed fractions of energy to the TMS for monoenergetic electrons for sources in (A) the TMS, (B) the TBE, and (C) the TBV. Three trabecular bone sites are shown: the cervical vertebrae (■), the parietal bone (□), and the ribs (◆). The ICRP Publication 30 recommended absorbed fractions are also represented in all three graphs (*72*).

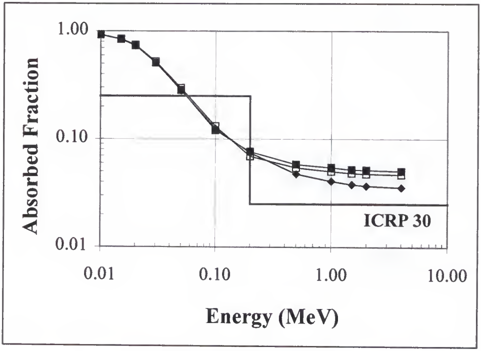


(C): S = TBV, T = TMS

Figure 3.8: Continued.

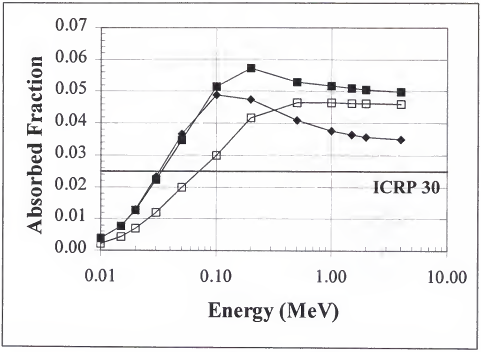


(A): S = TMS, T = TBE



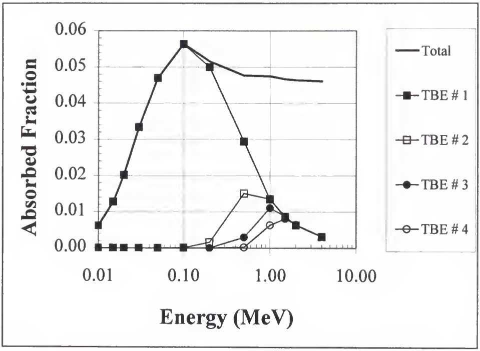
(B): S = TBE, T = TBE

Figure 3.9: Absorbed fractions of energy to the TBE for monoenergetic electrons for sources in (A) the TMS, (B) the TBE, and (C) the TBV. Three trabecular bone sites are shown: the cervical vertebrae (■), the parietal bone (□), and the ribs (◆). The ICRP Publication 30 recommended absorbed fractions are also represented in graphs (B) and (C) (*72*).

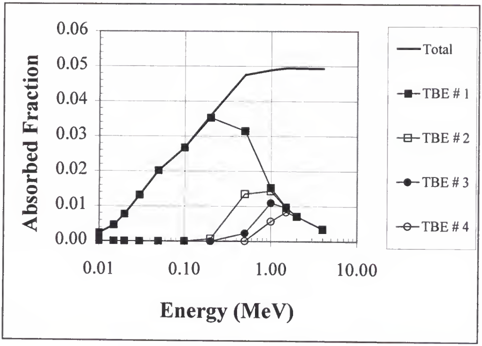


(C): S = TBV, T = TBE

Figure 3.9: Continued.

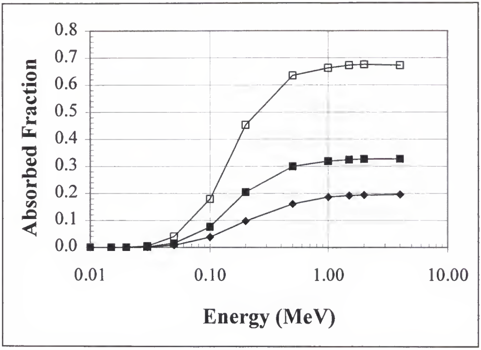


(A) Parietal Bone

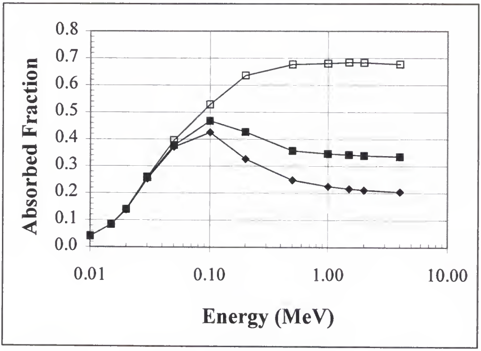


(B) Cervical vertebra

Figure 3.10: Absorbed fraction for the TBE as a target and the TMS as a source for (A) the parietal bone, and (B) the cervical vertebra. The total absorbed fraction to the TBE is partitioned as a function of the number of trabecular bone endosteal layers separating the TMS source and the TBE target considered (i.e., the TBE #1 is the TBE directly adjacent to the marrow space source).

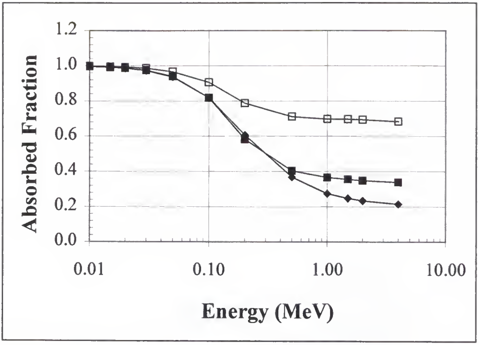


(A): S = TMS, T = TBV



(B): S = TBE, T = TBV

Figure 3.11: Absorbed fraction of energy to the TBV for monoenergetic electrons for sources in (A) the TMS, (B) the TBV, and (C) the TBV. Three trabecular bone sites are shown the cervical vertebrae (■), the parietal bone (□), and the ribs (◆).



(C): S = TBV, T = TBV

Figure 3.11: Continued.

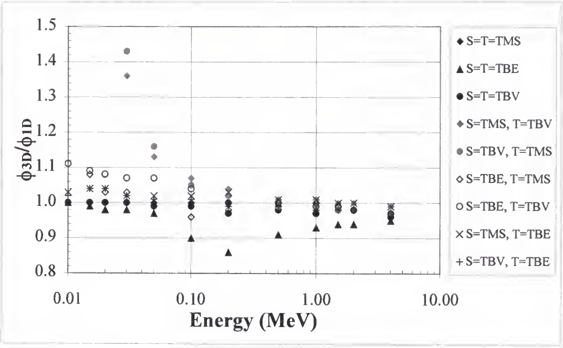


Figure 3.12: Ratios of absorbed fractions calculated using the three-dimensional transport model of electron transport in trabecular bone and the one-dimensional model, as a function of the electron initial kinetic energy. These ratios represent averages across all seven bone sites for each source-target combination. Individual differences at specific bone site can therefore exceed these values.

CHAPTER 4
MODEL OF ELECTRON TRANSPORT IN CORTICAL BONE

Introduction

The human skeletal system is a complex structure that can be classified in two distinct types: trabecular bone (a spongy mixture of bone spicules and marrow cavities) and cortical bone (hard, dense bone). These two bone types are microscopically very different, and therefore need to be considered separately for dosimetry purposes. Within the skeletal system, the cells at carcinogenic risk have been identified as the hematopoietic stem cells (active bone marrow), and the osteogenic cells, especially those on the endosteal surfaces and certain epithelial cells close to bone surfaces in the head (*52*). In the adult human skeleton, active marrow is located in the trabecular bone regions. Osteogenic cells are found on the surfaces of the trabecular bone cavities and lining the Haversian canals within cortical bone. For this reason, when one wants to calculate the dose to the skeletal system, both trabecular and cortical regions have to be considered separately.

Cortical bone is found in the outer wall of all bones and in the shafts of the long bones. Its structure is composed of osteons or Haversian systems. The osteon is a cylindrical system running approximately parallel to the long axis of the long bones, which has at its center a canal called the Haversian canal. Each of these canals contains blood vessels, lymphatic nerves and connective tissue and is lined by a layer of endosteum. The Haversian canals are linked by transverse Volkmann canals that connect them to sites of bone marrow and to the exterior surface of bone. These canals contains only blood vessels, and are fewer in number compared to the Haversian canals. The wall of the osteon consists of concentric bone lamellae (layered bone). Each osteon are separated from each other by interstitial lamellae (irregularly shaped systems of lamellar bone) and cement lines. The concentric and interstitial lamellae as well as the cement lines are composed of bone matrix which contain both inorganic and organic components. Typical structural dimensions of the components of the cortical bone are given in Table 4.1. The Figure 4.1 shows a diagram of a portion of the shaft of a human long bone illustrating the microstructure of the cortical bone.

In cortical bone, the cells at risk with respect to radiation are the osteoprogenitor cells that lie within the 10-μm layer of endosteum (*85*). Therefore, for dosimetric purposes, the cortical bone can be considered to consist of the cortical bone matrix (organic and inorganic components and enclosed osteocytes) and the soft tissue components of the Haversian systems.

In this paper, a three-dimensional transport model of electrons in cortical bone is presented. It is based on transverse path length measurements through Haversian canals and the mineralized bone tissue component of cortical bone as performed by Beddoe (*54, 86*). Absorbed fractions of energy for monoenergetic electron sources are subsequently calculated using the EGS4/PRESTA Monte Carlo transport code (*9, 10*) considering three cortical bone regions (shaft of femur, tibia and humerus), and all source and target combinations (bone volume, endosteum, and other soft tissues within the Haversian canals).

Previous Dosimetric Models of Cortical Bone

Beddoe et al.

In 1976, A. H. Beddoe used a bone scanning microscope to measure transverse chord lengths through Haversian cavities and the intervening cortical bone matrix (*54, 86*)[2]. This bone scanning microscope was originally developed for path lengths measurements in trabecular bone (*56*), and was further extended to measure the small cavities in cortical bone. Stained sections of transverse slices of cortical bone (20-30 μm thick) were scanned in order to obtain transverse chord length distributions of the Haversian cavity sizes and cortical bone matrix, the latter defined as the distances between Haversian cavities. With this optical scanning system, an effective resolution of about 8 μm was achieved. The transverse chord length distributions obtained by Beddoe are shown on Figure 4.2 A for the cortical cavities and on Figure 4.2 B for the mineralized component for a 50 year-old adult male. Beddoe made measurements of the cortex in three cortical bones the humerus, the tibia, and the femur. These chord length distributions are given in table format in Appendix E of this document. In his measurements, Beddoe assumed that the Haversian cavities ran parallel to the long axis of the bone, which is generally the case for the long bones. He also assumed that the number of transverse canals (Volkmann canals) appearing in the transverse planes was negligibly small. This last assumption was verified visually on his stained sections of cortical bones. Beddoe also looked at the iliac crest, but his measurements showed irregular fluctuations due to scanning only one small section. Average transverse chord lengths for these three long bones are given in Table 4.2.

---

[2] In the sample preparation procedures of Beddoe, all soft tissues were removed prior to optical scanning. Consequently, we make a distinction between (1) the Haversian cavity (total soft tissue volume defining the Haversian canal and its constituent endosteal layer), and (2) the Haversian space (soft tissues within the canal exclusive of the endosteum).

Beddoe followed the technique employed by Whitwell (*67, 68*) for the dosimetry of trabecular bone, on his cortical chord length measurements. This technique assumes a straight path of the electron through Haversian cavities and cortical bone matrix, and uses a range-energy relationship with random sampling of chords to derive dose conversion factors. These dose conversion factors were only published in the dissertation of Beddoe (*54*), and only for a limited number of radionuclides used in health physics (^{14}C, ^{18}F, ^{22}Na, ^{32}P, ^{45}Ca, ^{90}Sr, ^{90}Y). Moreover, the only source considered in his study was the bone volume. However, both the endosteum and Haversian canals are of interest for nuclear medicine and health physics dosimetric applications.

G. Akabani

Another study on cortical bone dosimetry was performed by Akabani in 1993 (*87*). He calculated absorbed fractions of energy to single Haversian canals, and derived dose factors for several beta-emitting radionuclides (^{32}P, ^{45}Ca, ^{89}Sr, ^{90}Sr, ^{90}Y, ^{131}I, ^{153}Sm). This single Haversian canal was modeled as a cylinder surrounded by cortical bone matrix. Only six Haversian canal sizes were considered with radii of 5, 10, 20, 30, 40, and 50 μm. The Monte Carlo transport code EGS4-PRESTA was used to derive electron absorbed fractions of energy for two sources (Haversian canal and bone surface) and three targets (Haversian canal, endosteum, and the bone matrix). From these calculations, he tabulated dose conversion factors for seven radionuclides as a function of the Haversian canal radius.

There are two limitations to this work. The first one is that a single radius of the Haversian canal was used without considering a distribution of radii. Secondly, since the average transverse distance between Haversian canals is approximately 900 µm (*54, 86*) and the range of a 500 keV electron through bone is about 1,000 µm (*83*), cross-osteon irradiation should be considered for electron energies greater than 500 keV.

Materials and Methods

The model of electron transport in cortical bone presented here attempts to account for the limitations of the two previous cortical bone models of Beddoe (*54*) and Akabani (*87*) by considering (a) the non-linear trajectory of the electrons, (b) the full transport of the electrons with delta-rays and bremsstrahlung, (c) the distribution of sizes of Haversian canals, and (d) cross-osteon irradiation.

The transverse chord lengths distributions measured by Beddoe through cortical cavities and cortical bone matrix are used for this model since they currently give the most complete information on the microstructure of adult cortical bone (*54, 86*). They are used following the methodology proposed by the authors in a model of electron transport in trabecular bone (*88*). One difference in the models proposed for both trabecular and cortical bone is that the chord length distributions available for the trabecular bone are omnidirectional, while for the cortical bone they are transverse (plane perpendicular to the bone axis).

Transport model

The transverse chord lengths through Haversian cavities and bone matrix are used to limit the transport of the particles in a given region. In the transport model, they represent the distance in the transverse plane between two different cortical bone regions, and in this respect may be used to determine the change in region during particle transport. By sampling many different chords, for many electrons, the average transport of an electron in cortical bone is thus simulated.

Another characteristic we know about the cortical bone is that the Haversian cavities (the Haversian space and its surrounding endosteum) are approximately cylinders running parallel to the long axis of the bone (Figure 4.1), with a diameter around 100 times smaller than their length (Table 4.1). Consequently, in the transport model, all regions are represented by parallel portions of cylinder. The escape of the particle from the cortical bone is not simulated; therefore, these cylinders are not limited by any planes in the direction of their axis.

In the transport model, a transverse chord length is randomly sampled each time an electron enters a new region. This chord length gives the distance in the transverse plane between the particle entry points of the new region and the succeeding region. Thus, the particle transport is limited by a cylinder centered at the point of entry and of radius given by the sampled chord length. In order to take into account possible backscattering of the particle, only half a cylinder is used, with its cutting plane defined by the direction of travel of the particle. Figure 4.3 A shows a diagram of this transport geometry.

The chord length distributions are only available for the Haversian cavities and cortical bone matrix. The cavities include the Haversian space, and the surrounding 10-μm layer of endosteum (*52, 76*). In order to derive corresponding chord lengths for the endosteum layers and the Haversian space, it is assumed that in the transverse plane the angles of entry θ_1 and θ_2 in both endosteal layers for the cavity chord are selected randomly. Then, since the thickness of the endosteal layer is fixed, the chords for both endosteal layers can be derived:

$$d_{E1} = (10\,\mu m)\sec(\theta_1), \text{ and} \qquad \text{Eq. 4.1}$$

$$d_{E2} = (10\,\mu m)\sec(\theta_2), \qquad \text{Eq. 4.2}$$

Therefore, to derive transverse chords for the endosteal layers and the Haversian space, a random Haversian cavity chord d_{HC} is first sampled along with two endosteum entry angles θ_1 and θ_2. Then, both transverse chords through the endosteum d_{E1} and d_{E2} and through the Haversian space d_{HS} can be derived as followed:

if $d_{E1} + d_{E2} \geq d_{HC}$

$$\begin{aligned} d_{E1} &= d_{E2} = \frac{d_{HC}}{2}, \text{ and} \\ d_{HS} &= 0. \end{aligned} \qquad \text{Eq. 4.3}$$

Otherwise if $d_{E1} + d_{E2} \leq d_{HC}$,

$$\begin{aligned} d_{E1} &= (10\,\mu m)\sec(\theta_1), \\ d_{E2} &= (10\,\mu m)\sec(\theta_2), \text{ and} \\ d_{HS} &= d_{HC} - (d_{E1} + d_{E2}). \end{aligned} \qquad \text{Eq. 4.4}$$

Figure 4.3 B demonstrates how these three transverse chords are derived and used in the transport model.

The determination of the starting region needs to be consider separately. The measurements of transverse chord length distributions in cortical bone performed by Beddoe were made under a μ-random distribution meaning that a chord is defined by a random point in space and a random direction (*77-79*). If one wants to simulate a particle originating within the Haversian space or within the bone matrix, one needs to use an I-random distribution, meaning that a chord is defined by a point interior to the region and a given direction. To derive a I-random chord distribution from a μ-random chord distribution, the following relationship can be used:

$$f_I(d) = \frac{d}{\langle d \rangle_\mu} f_\mu(d), \qquad \text{Eq. 4.5}$$

where $f_I(d)$ and $f_\mu(d)$ are the probability density functions for chord lengths under I- and μ-randomness, respectively, and $<d>_\mu$ is the average chord length under μ-randomness (*77*). Thus, using this derived I-random chord distribution, an interior chord length d_I can be derived for both Haversian spaces and cortical bone matrix. After choosing an interior chord d_I, a starting internal distance d_0 between 0 and d_I is randomly selected. This selected distance limits the distance traveled in the transverse plane by the electron in the initial source region. In this case, the starting electron is placed at the origin of the coordinate system on a cylinder axis of radius d_0, and its starting direction is randomly selected. This places the electron at a distance d_0 in the transverse plane from the next region, but allows the electron to travel in the three-dimensions. Figure 4.3 C shows a diagram of the starting source region. In the case of a source taken in the Haversian space, two random angles of entry through both endosteal layers are selected, and the corresponding distances decrease the sampled transverse interior chord for the Haversian cavity.

In the case of the endosteum as a source, an approximate radius of a cavity cylinder containing the endosteum is derived. This is only used to take into account the relatively large curvature of the endosteum surfaces due to the very small size of the Haversian cavities. This radius is derived by randomly sampling a transverse chord length d through the Haversian cavities, and by assuming that this chord is the average chord <d> of a disc of radius R (*77*):

$$\langle d \rangle = \frac{4}{\pi} R \,. \qquad \text{Eq. 4.6}$$

From this expression, a cylinder of radius R is created, and a random point is selected within a 10-μm distance from its edge. When the electron exits the starting endosteal region, the method of region creation presented above is used. Note that the cylinder is never used as a transport region.

The Figure 4.4 summarizes in diagram form the presented model of electron transport in cortical bone. The Haversian space is considered the source. In this diagram, a backscattered electron is shown in panels 3a and 3b.

Transport parameters

The EGS4 Monte Carlo transport code (*9*) along with the PRESTA algorithm (*10*) is used to simulate the transport of the electrons within cortical bone. The composition of each of the cortical bone regions was derived from ICRU Report 46 (*81*). The composition of the Haversian space was taken as blood, the endosteum as soft tissue, and the bone matrix as cortical bone. We acknowledge that the ICRU composition of cortical bone does include the constituent tissues of the Haversian space; nevertheless, these tissues comprise only a small fraction of the cortical bone volume. The Table 4.3 gives the percentage by mass and density of each medium.

The other transport parameters used for the EGS4 code are an ECUT of 512 keV, PCUT of 1 keV (total energy cut-off for the transport of electron and photon respectively), and an ESTEPE of 2% (maximum percent energy loss per step in the continuous slowing down approximation). Bremsstrahlung photons were followed up to a distance not to exceed 5 cm from the center of the original region. Twelve electron energies are simulated between 10 keV and 4 MeV, with a total of 20,000 sampled particles per energy. The energy deposited in all cortical bone regions is stored, and absorbed fractions are derived for the cortical Haversian space (CHS), the cortical bone endosteum (CBE), and the cortical bone volume (CBV) as source and target regions. Corresponding standard deviations of the absorbed fraction are also derived for all source, target, and energy combinations.

Results and Discussion

Electron absorbed fractions of energy are calculated for the three cortical bone sites measured by Beddoe (*54, 86*). The results of absorbed fractions for all target regions are given in Appendix F in Table F.1 for the CHS as a source, Table F.2 for the CBE as a source, and Table F.3 for the CBV as a source. Along with the absorbed fractions for the three cortical bone sites is given the averages between all three bone sites. This average absorbed fraction is to be used for other cortical bones from which the chord length distributions are not available. The calculated coefficient of variations (CV) are less than 0.5% when the source and the target region are equal. When the source and target are different, the CV were generally less than 5%, except at very low energies (10 keV, 15 keV, and 20 keV), where some values of the CV were as high as 50%.

Self-absorbed fraction of energy

Graphs of self-absorbed fractions are given in Figure 4.5 for all three cortical bone regions. One can first notice that there are small variations of the self-absorbed fraction between cortical bone sites due to the small differences in their respective chord length distributions. For all three cortical regions, the self-absorbed fraction decreases with increasing energy. This decrease is more pronounced for the Haversian space and the endosteum due to their very small sizes. For the bone matrix, the absorbed fraction is very close to unity due to the very large volume occupied by this region (Table 4.1). For all regions, the decrease seems to be less abrupt for energies greater than 1 MeV, where cross-osteon irradiation begins to be significant.

Also shown in Figure 4.5 B are values of absorbed fraction for self-irradiation of the CBE as recommended in ICRP Publication 30[3]. The ICRP 30 model assigns an absorbed fraction of 0.25 for mean beta energies below 200 keV, and an absorbed fraction of 0.015 for mean beta energies exceeding 200 keV. The ICRP 30 model is shown to underestimate the absorbed fraction, relative to the present model, at electron energies below ~60 keV and at energies exceeding 200 keV. Discrepancies at very low energies are attributable to differences in source region definition. In the present model, the endosteum is considered as a 10-μm thick volume source with absorbed fractions close to unity at very low source energies. The ICRP 30 model assumes a true surface source for "surface-seeking" radionuclides in which a larger portion of the emitted energy is lost to the neighboring bone matrix.

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[3] The cortical bone model of ICRP Publication 30 is used within the internal dose computer code MIRDOSE2. The corresponding model for cortical bone used in MIRDOSE3 has not as yet been published.

Cross-absorbed fraction of energy

Graphs of absorbed fractions when the source is different than the target region are given in Figure 4.6. In the case of the CHS as the target (Figure 4.6 A and B), we see larger variations of the absorbed fraction with bone site. The cortex of the tibia, which has the largest Haversian canals, has the largest absorbed fraction at all electron source energies. When the CBE is the source (Figure 4.6 A), the absorbed fraction is not zero at low energy due to the small thickness of the endosteum, and it increases very rapidly to reach a maximum around 60 keV. This maximum corresponds to the energy at which all electrons originating in the endosteum reach the Haversian space. For higher energies, the absorbed fraction decreases as electrons start to escape the Haversian space and enter the adjacent bone matrix. We see a different shape for the absorbed fraction when the source is the CBV, and the target is the CHS. The absorbed fraction first starts at zero. At energies greater than 100 keV, more electrons reach the CHS, and the absorbed fraction subsequently increases. At 1 MeV, an equilibrium is reached at which the electron energy entering the CHS is equal to the electron energy exiting the CHS.

Figure 4.6 C and D shows the absorbed fraction to the CBE for the CHS and CBV as source regions, respectively. One can see in these two graphs the same variations of the absorbed fraction that were observed for the CHS as a target due to their very small

sizes compare to the bone matrix. One can also notice that the absorbed fraction to the CBE is smaller than the absorbed fraction to the CHS at all energies.

Figure 4.6 D additionally indicates the energy-independent absorbed fraction of 0.015 recommended in ICRP Publication 30 for this particular source-target combination. The ICRP 30 model is shown to greatly overestimate the absorbed fraction to cortical endosteum at energies below ~500 keV. At 10 keV, the ICRP 30 value is a factor of ~300 greater than that predicted by the current model. At high electron energies, the current model predicts absorbed fractions higher that the ICRP 30 value, but only by factors ranging from 1.7 to 1.8.

The absorbed fraction to the CBV is represented in Figure 4.6 E and F for the CHS and CBE as source regions, respectively. We first see almost no variations of the absorbed fraction with the cortical bone site due to the small differences in the chord length distributions. We also can see very different variations of the absorbed fractions with energies from what was observed previously for the CHS and CBE as target regions. The bone matrix volume represents ~95% of the cortical bone (Table 4.1), therefore once an electron enters the bone, it will deposit almost all its energy within this region. That is why we see a continuous increase of the absorbed fraction with increasing energy plateauing at ~1 MeV. This increase is more abrupt for the CBE as a source (directly adjacent to the bone) than for the CHS.

Summary and Conclusions

A model of electron transport in cortical bone has been presented. This model extends to cortical bone the model of electron transport in trabecular bone presented by

Bouchet et al. (*88*). It uses the transverse chord length distributions through Haversian cavities and bone matrix measured by Beddoe (*54, 86*). This model takes into account the non-linear trajectory of the electrons, the full transport of the electrons with delta-rays and bremsstrahlung, the distribution of sizes of Haversian canals, and the possible cross-osteon irradiation at high electron energy.

Using the electron transport code EGS4-PRESTA, absorbed fractions of energy for monoenergetic electrons are tabulated for twelve energies, considering all source and target regions in the cortical bones. The three available chord length distributions are used for this purpose. Since these chord length distributions are only for the long bones, an average of the calculated absorbed fractions is also tabulated for use with other cortical bone sites.

The possible escape of the electron from the cortical bone is not fully accounted for in the present model. Bremsstrahlung photons are limited to a distance of 5 cm from the starting source region, and 2% energy escape is seen at 4 MeV. No attempt is made to simulate the real outer shape of these long bones; therefore, the absorbed fractions presented here will slightly overestimate the true absorbed fractions especially at high electron energies, and for thin sections of cortical bones (as in the cortex of the femur head and neck, for example).

Considering that the dose to the endosteum is necessary for the calculation of effective dose (*89*), and since 40% of the mass of endosteum is located in the cortical bone (*25*), it is important to precisely calculate the dose to the cortical endosteum even in nuclear medicine applications. This electron transport model and its corresponding calculated absorbed fractions of energy will help in the accurate determination of endosteal dose. Furthermore, any radionuclides injected in the blood stream will remain in the blood for a certain time, and therefore will be seen within the Haversian canals. These newly calculated absorbed fractions will allow for the dose from Haversian canal sources to be more accurately calculated than allowed in existing models.

Table 4.1: Typical geometrical dimensions of a human adult osteon (Haversian system) (*54*).

Feature	Typical Dimensions
Osteon length (between Volkmann canals)	2,500 μm
Concentric lamelae thickness	7 μm
Osteon diameter	200 - 400 μm
Haversian canal diameter	20 - 200 μm
Endosteum thickness	10 μm

Table 4.2: Calculated average transverse chord lengths through the Haversian cavities and through cortical bone matrix of three different cortical bone sites. The percentage bone volume calculated by Beddoe is also given (*54, 86*).

Cortical Bone Site	**Average Transverse Chord***		**% volume of bone matrix**
	Haversian cavities	**Bone matrix**	
Femur Cortex	78	856	93.4
Tibia Cortex	100	870	94.6
Humerus Cortex	78	870	95.4

* The original transverse chord length data were not available from the author or his publications. Consequently, these distributions were graphically estimated from figures given in the original thesis (see reference *54*). For these reasons, the averages given in this table differ slightly from values published in references (*54, 86*).

Table 4.3: Elemental composition (% by mass) of the different media used for the simulation of electron transport in cortical bone (*81*).

Element	**Haversian Space (Blood)**	**Endosteum (soft tissue)**	**Bone Matrix (cortical bone)**
H	10.2	10.5	3.4
C	11.0	25.6	15.5
N	3.3	2.7	4.2
O	74.5	60.2	43.5
Na	0.1	0.1	0.1
Mg			0.2
P	0.1	0.2	10.3
S	0.2	0.3	0.3
Cl	0.3	0.2	
K	0.2	0.2	
Ca			22.5
Fe	0.1		
Mass Density (g cm^{-3})	1.06	1.03	1.92

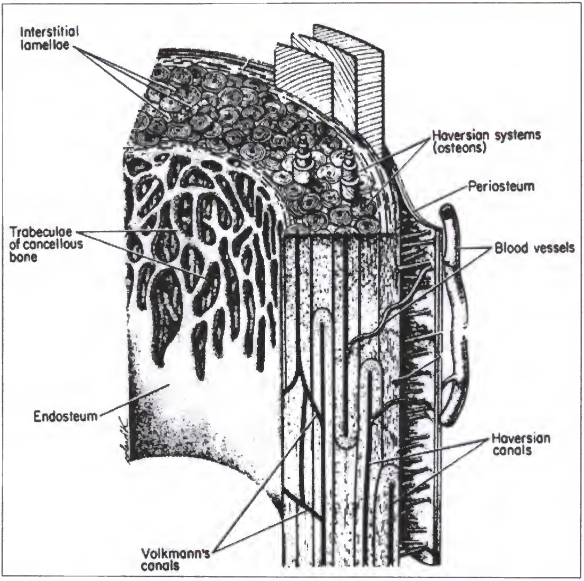
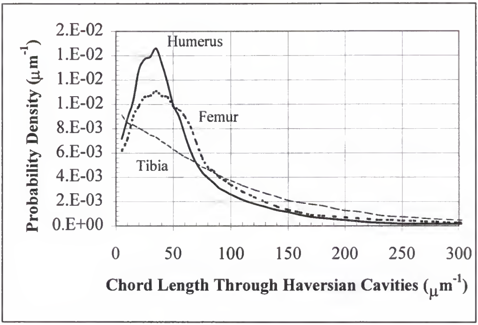
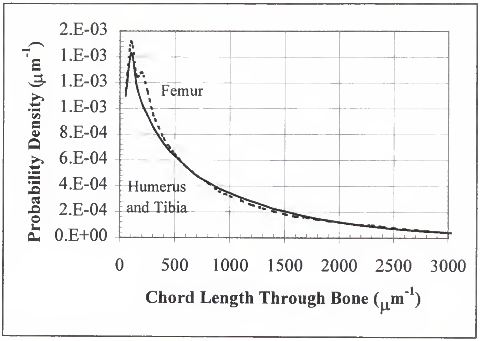


Figure 4.1: Sketch of a region of the shaft of a human long bone showing the osteon (Haversian system) within the cortical bone (adapted from ICRP Publication 70 (*25*)).



(A)



(B)

Figure 4.2: Transverse path length distributions of (A) Haversian cavities (Haversian canal and endosteum) and (B) transverse mineralized component (distance between cavities) in the cortex of the femur, tibia, and humerus of a 50 year-old male (*54, 86*).

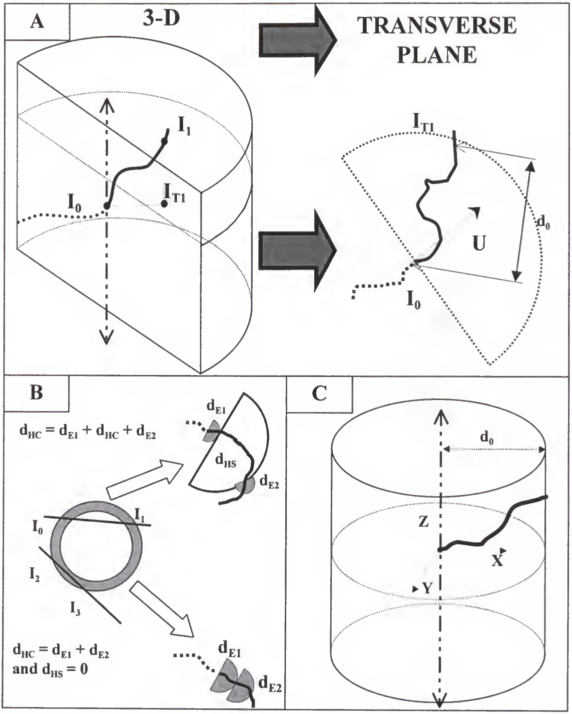


Figure 4.3: Diagrams illustrating the model of electron transport in cortical bone. In (A) is shown how the transverse chord lengths are used to limit the transport in the transverse plane by using half cylinders. In this graph, the electron enters at I0, and exits at I1. In the transverse plane, the distance (I0,IT1) is equal to the sampled chord length d0. In (B) is demonstrated how the measured Haversian cavity chords (I0I1) and (I2I3) are used to derive endosteum chord lengths (dE1 and dE2) and Haversian space chord length dHS. In (C) is shown the cylindrical source region in cortical bone derived from I-random chord length distributions.

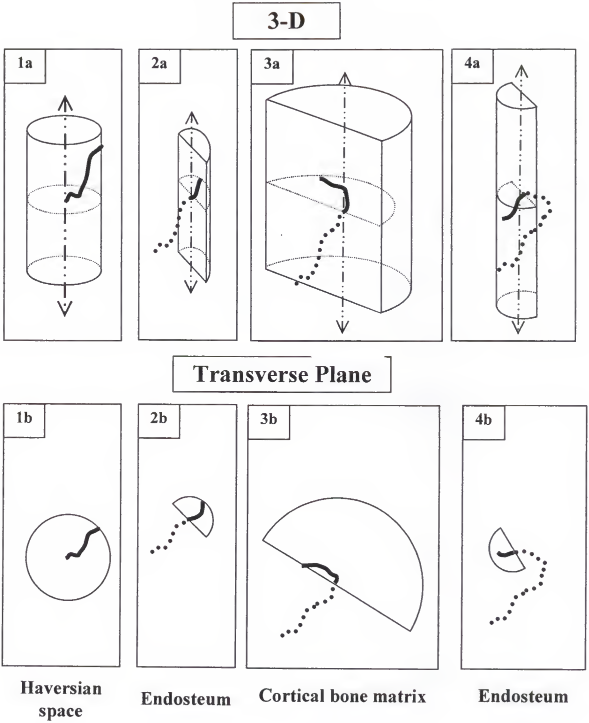
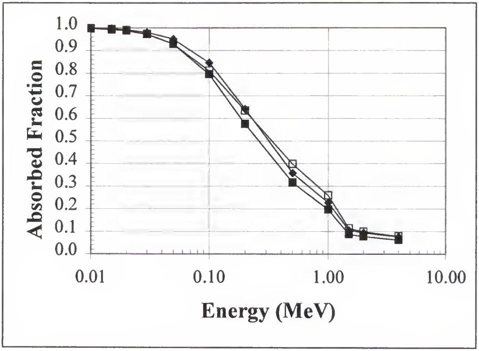
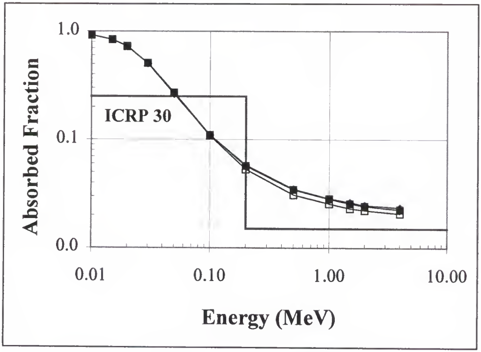


Figure 4.4: Model of the electron transport in cortical bone. The source is the Haversian space, and therefore a random chord length is sampled from the I-random distribution. After exiting the source region, the electron enters an endosteum region at a random angle. Then, the electron enters the bone matrix, and backscatters into the endosteum layer. Both (a) the three-dimensional and (b) transverse diagrams are shown.

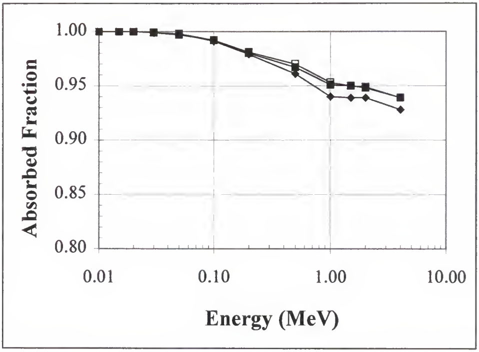


(A): S = CHS, T = CHS



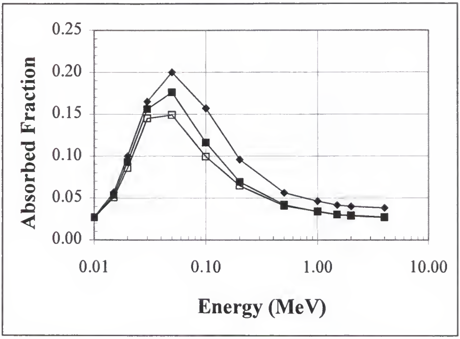
(B): S = CBE, T = CBE

Figure 4.5: Self-absorbed fraction of energy for monoenergetic electrons located in the (A) the CHS, (B) the CBE, and (C) the CBV. All three cortical bone sites from which the chord length distributions were available are shown: the cortex of the femur (■), humerus (□), and tibia (◆).

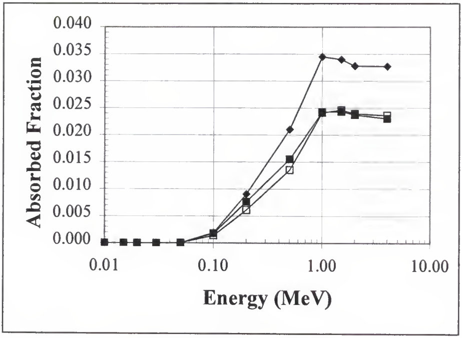


(C): S = CBV, T = CBV

Figure 4.5: Continued.

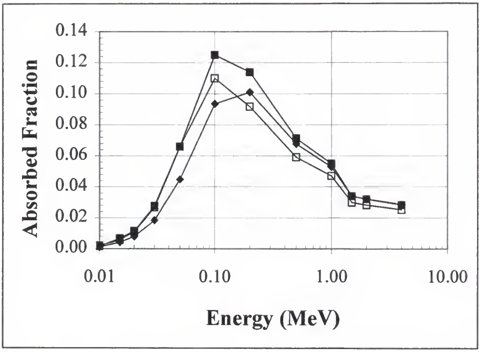


(A): S = CBE, T = CHS

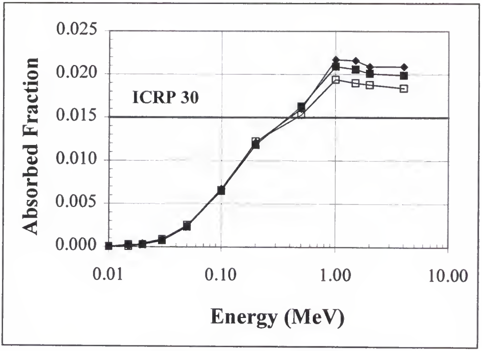


(B): S = CBV, T = CHS

Figure 4.6: Cross-absorbed fractions of energy for monoenergetic electrons for six source-target combinations. Graphs (A) and (B) are for the CHS as a target, and the CBE and CBV as source regions, respectively. Graphs (C) and (D) are for the CBE as a target, and the CHS and CBV as source regions, respectively. Graphs (E) and (F) are for the CBV as a target, and the CHS and CBE as source regions, respectively. All three cortical bone sites from which the chord length distributions were available are shown: the femoral cortex (■), the humerus cortex (□), and tibia cortex (◆).

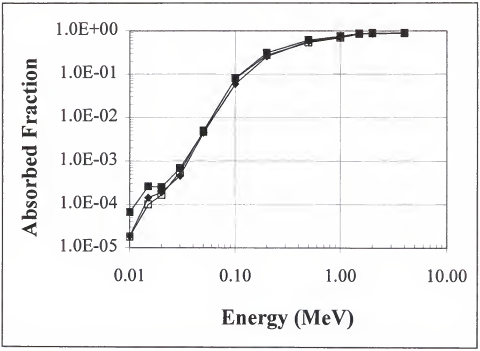


(C): S = CHS, T = CBE

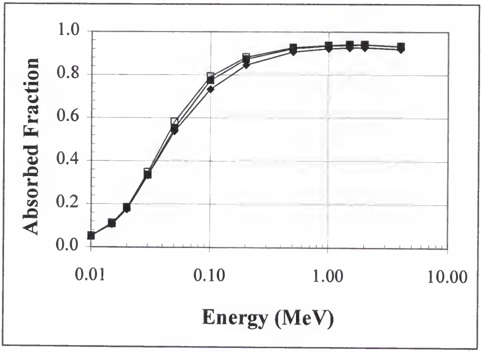


(D): S = CBV, T = CBE

Figure 4.6: Continued.



(E): S = CHS, T = CBV



(F): S = CBE, T = CBV

Figure 4.6: Continued.

CHAPTER 5
DERIVATION OF TRABECULAR AND CORTICAL S VALUES FOR USE IN SKELETAL DOSIMETRY

Introduction

In nuclear medicine, accurate skeletal dosimetry is important due to the high radiosensitivity of the hemaetopoietic cells contained within the marrow cavities of trabecular bone. Furthermore, in both radioimunotherapy and bone pain palliation, the red marrow is generally the dose-limiting organ (*49-51*).

Two new models of electron transport in trabecular bone and cortical bone were presented in Chapters 3 and 4 for the adult. These models are based on three-dimensional transport using the chord length distributions measured by the research group of Spiers for trabecular (*54, 55, 67, 68*) and cortical bone (*54, 86*). Using these models with the electron transport code EGS4 (*9-11*), new absorbed fractions of energy have been derived. For the trabecular bone, seven bone sites were considered with three source and target regions: the trabecular marrow space (TMS), the trabecular bone endosteum (TBE), and the trabecular bone volume (TBV). For the cortical bone, three cortical bone sites were considered with three source and target regions: the cortical Haversian space (CHS), the cortical bone endosteum (CBE), and the cortical bone volume (CBV).

In this chapter, S value tabulations are presented using these two new transport models. New reference masses are derived for 22 bone sites based on data given in ICRP

Publication 70 (ICRP-70) (*25*). S values are given for all source-target combinations available from the transport models, and for each of the 22 bone sites. Skeletal averaged S values are also derived. The newly calculated S values are then compared with S values currently used in clinical medicine.

Previous Dosimetric Models of Cortical and Trabecular Bone

The first calculation of S values for use in nuclear medicine skeletal dosimetry were made by Snyder et al. in 1974 (*70*). The authors published an Oak Ridge National Laboratory report number 5000 (ORNL-5000) in which photon specific absorbed fractions and radionuclides S values were given for combinations of source and target organs in an adult heterogeneous phantom. For beta-emitter radionuclides, they generally assumed that all ionizing particle energy was deposited in the source organ of interest (except for sources within the GI tract). In the case of the skeletal system, however, they used more advanced calculations based mainly on the work of Spiers and his students at the University of Leeds (*56, 67, 68*). To simulate electron transport in the skeleton, Spiers' group used chord length distributions measured in the cavities and bone matrix of both trabecular bone and cortical bone, along with electron range-energy relationships in these tissues. They subsequently derived dose factors (dose per unit activity concentration in the bone matrix) for several radionuclides of interest in health physics (^{14}C, ^{18}F, ^{22}Na, ^{32}P, ^{45}Ca, ^{90}Sr, ^{90}Y) considering the red marrow, and the endosteum (both trabecular and cortical) as target regions, and the trabecular bone volume and cortical bone volume as source regions. Snyder et al. later converted these dose factors to specific absorbed fractions of energy as a function of the average beta particle energy for each of these seven radionuclides. In ORNL-5000, Snyder et al. considered four source regions: trabecular bone, cortical bone, red marrow, and yellow marrow, along with four target regions: skeletal bone (both trabecular and cortical), red marrow, yellow marrow, and skeletal endosteum (both trabecular and cortical). For the skeletal source-target combinations that Spiers did not consider, Snyder et al. applied one of the following five assumptions to estimate values of absorbed fraction: (a) no energy deposition, (b) full energy deposition, (c) conservation of energy within neighboring regions, (d) uniform energy deposited per unit mass, and/or (e) the reciprocity theorem. Table 5.1 summarizes all methods and assumptions used to derive absorbed fractions of energy for various source-target combinations. In 1975, the ORNL-5000 S values were also published by the Medical Internal Radiation Dose (MIRD) Committee of the Society of Nuclear Medicine in its Pamphlet No. 11 (MIRD-11) (*5*). For the case of the skeletal system, only three sources were considered by the MIRD Committee (trabecular bone, cortical bone, and red marrow), along with two targets (red marrow and skeletal bone tissue). These values are presumed to have come directly from the ORNL-5000 as noted in page six of the companion document Pamphlet No. 5-Revised (*20*); however, a 10% difference can be noted between ORNL-5000 and MIRD-11 in the case of the red marrow as both a source and target region. No differences are found for the other source-target combinations within the skeleton.

In 1979, the ICRP published its Report No. 30 (ICRP-30) in which it recommended absorbed fractions of energy for use in skeletal dosimetry (*72*). These recommended absorbed fractions are also derived from the work of Spiers (*54-56, 67, 68*). Four source regions are considered (trabecular bone endosteum, trabecular bone volume, cortical bone endosteum, and cortical bone volume) along with two targets (red marrow and skeletal endosteum). In the case of beta particles originating in the bone volume, a single value of absorbed fraction is recommended, and in the case of beta particles originating on the bone surface, one absorbed fraction is recommended for low-energy beta particles (mean beta energy less than 0.2 MeV), and another value for high-energy beta particles (mean beta energy greater than 0.2 MeV). These recommended absorbed fractions are listed in Table 5.1.

Subsequently, these rather energy-independent absorbed fractions of energy were implemented within the MIRDOSE2 program (*73*) for use in nuclear medicine dosimetry. Sources considered in this program are the red marrow and the bone volume. Following the methodology used in the ICRP-30 bone model, radiopharmaceutical sources are located on the bone surface if the radionuclide physical half-life is less than 15 days or on the bone matrix otherwise. In the case of the red marrow as a source region, it was assumed that the full particle energy is deposited in the red marrow as suggested in the preface of Part 3 of the ICRP Publication 30 (*72*). Table 5.1 lists all absorbed fractions used within the MIRDOSE2 program.

In 1985, Eckerman (*74*) presented a new model of electron transport in trabecular bone based on the chord length distributions measured by Spiers and his students (*54-56*). Using their approach (i.e. sampling of chord length distributions and electron range-energy relationships), Eckerman derived absorbed fractions of energy for monoenergetic electrons within the seven trabecular bone sites considered earlier by Spiers. These calculations were primarily intended to be used in radiation protection, for photon sources within the ORNL mathematical phantom (*18*) in deriving dose-to-photon fluence conversion factors (*74*). In 1994, the S values derived from these calculations were implemented within the MIRDOSE3 program to be used in nuclear medicine dosimetry (*73*). Target regions considered in MIRDOSE3 are the red marrow and the skeletal endosteum (both cortical and trabecular), and sources regions considered are the trabecular bone volume, the red marrow, the cortical bone volume, the trabecular bone surface, and the cortical bone surface. The S values are given for fifteen different bone sites in the skeletal system and for the two target and four source regions. Skeletal averaged S values are also given based on site-specific S values for these fifteen bone sites. The only document fully describing the physics used in this model is a 1985 symposium article by Eckerman (*74*). In this article, a transport model for electrons in trabecular bone is presented; no transport model for electrons in cortical model is discussed. Furthermore, in this paper it is not clear as to how the bone surface (i.e., endosteum) was simulated as either a target or a source region. The source and target region combinations used in this program are shown in Table 5.1.

Another important aspect of the dosimetry of the skeletal system is the choice of reference masses for the different target regions. Reference masses are needed when S values are calculated. In the ORNL-5000 (*70*) and in the MIRD-11 (*5*) S value calculations, it was assumed that the reference mass for the red marrow was 1,500 g as given by the ICRP Publication 23 (*39*)[4]. In the MIRDOSE2 program, this mass was reported to also be 1,500 g (*73*), however, we calculate a value of 1,120 g using the MIRDOSE2 S value for ^{32}P and an absorbed fraction of unity when the marrow is considered as both source and target. A red marrow mass of 1,120 g corresponds to that used for the adult in both the 1980 and 1987 reports by Cristy and Eckerman in their tabulations of dosimetric data for the ORNL mathematical phantom series (*17, 18*). A mass of 1,120 g is also used for the red marrow within the adult in the MIRDOSE3 program. Mass fractions of red marrow indexed by bone site can also be found in the documentation of the MIRDOSE3 program (*73*), although details and references for their derivation are not given. Other important skeletal masses used to calculate S values include 5,000 g for the whole skeleton bone in both ORNL-5000 and MIRD-11, and 120 g for the total mass of skeletal endosteum in ICRP-30 and in both the MIRDOSE2 and MIRDOSE3 programs.

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[4] Page 90 of ICRP Publication 23 (39) indicates a reference red marrow mass of 1,500 g. On the following page, however, data contained within Table 31 of the same ICRP publication more accurately indicate that only 1,045.7 g of the 1,500 g is hematopoietically active within the trabecular regions of the adult skeleton. This volume was later revised to 1,120 g by Cristy (17, 18), and to 1,170 in ICRP-70 (25).

Materials and Methods

Choice of Skeletal Absorbed Fractions of Energy

In the tabulation of regional skeletal S values, it is proposed that the models of electron transport in trabecular bone and cortical bone developed by Bouchet et al (*53, 88*) be used. These two models are based on the chord length distribution measurements of Spiers (*54-56, 67, 68, 86*). In these models, the Monte Carlo transport code EGS4/PRESTA (*9-11*) was used for the transport of electrons, allowing for full three-dimensional transport of these particles through both cortical and trabecular soft tissue cavities and bone matrix. For the model of electron transport in trabecular bone, three source and target regions are considered: the trabecular bone volume (TBV), the trabecular bone endosteum (TBE), and the trabecular marrow space (TMS). Tabulation of absorbed fractions were given for all source and target combinations for seven bone sites: the cervical vertebrae, the femur head, the femur neck, the iliac crest, the lumbar vertebrae, the parietal bone, and the rib bone. For the model of electron transport in cortical bone, three source and target regions are considered: the cortical bone volume (CBV), the cortical bone endosteum (CBE), and the cortical Haversian space (CHS). Absorbed fractions data were given for three bone sites: the humoral cortex, the femoral cortex, and the tibial cortex. For a detailed description of these models, the reader is referred to references *53* and *88*.

Reference Skeletal Masses

Using these new absorbed fractions of energy for trabecular and cortical bone, S values to the skeleton can be derived for various radionuclides. However, to calculate S values, reference masses are also needed for each of the different targets within trabecular and cortical bone sites of the skeleton. In 1995, the ICRP published its Report 70 (ICRP-70) giving anatomical and physiological data on the human skeletal system for use in radiological protection (*25*). This publication serves as an update to the skeletal chapters of ICRP Report 23 (*39*). In this report, reference masses are given for the total skeleton, but not for specific bone sites. Also in this report, summaries of different quantitative data from the literature on the skeletal system are given in table form. These data can thus be used to derive bone site-specific masses for all sources and targets of interest in skeleton dosimetry.

From ICRP-70, we first selected 22 bone sites in six skeletal body regions to represent all trabecular and cortical bone sites in the adult (Table 5.2). For S value calculations in all source-target combinations, the following masses are needed for each of the 22 bone sites: the trabecular marrow space, the cortical Haversian space, the active marrow, the inactive marrow, the cortical bone, the trabecular bone, the cortical endosteum, and the trabecular endosteum masses. The following section explains how each of these masses are derived.

The mass for the total active marrow in Reference Man is given in page 67 of ICRP-70 as 1,170 g. In addition, Table 40 of ICRP-70, taken from a study published by Cristy in 1981 (*80*), gives the percentage of active marrow in a given bone as a percentage of the total active marrow in the body (see Table 5.3, column 2)[5]. From these data, the reference mass of active marrow in each of the 22 bone sites can be obtained (Table 5.3, column 3). Moreover, the percentage of total marrow space (both active and inactive) in individual adult bones was determined by Mechanik in 1926 (*90*) and later summarized by Woodard in 1960 (*91*). These percentages were given in Table 30 of ICRP Report 23 (*39*), and are included in the column 4 of Table 5.3. Knowing that the ICRP-70 Reference Man mass for the total marrow is 3,650 g (Reference Man mass of inactive marrow is 2,480 g), it is then possible to derive the total mass of marrow per bone site; the total mass of inactive marrow is obtained by subtraction (columns 5 and 6 of Table 5.3 respectively). To verify the derived masses of active, inactive, and total marrow, one may additionally calculate cellularity factors for each of the trabecular bone sites (percentage of total marrow mass that is active), and compare these values to published data in ICRP-70 (*25*). Table 41 of ICRP-70 gives values of cellularity factors for several bone sites and several ages originally given by Cristy (*80*). In Table 5.3, the computed cellularity factors are compared to those published data, and good agreement is seen.

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[5] Values are given in Table 40 of ICRP-70 for two adult ages: 25 year-old and 40 year-old. In the work reported here, we have utilized the data for the 40 year-old adult as this age more closely matches the age of the subject for which trabecular chord length data are available (44 year-old). Other reference masses in ICRP-70 are indicated for a 35 year-old.

To derive the mass of bone tissue within the trabecular and cortical regions of the skeleton, the relative weights of dry bones of adults as a percentage of the total dry skeleton given in Table 8 of ICRP-70 are used. Those data were measured by Trotter and Hixon in 1974 for 30 white males (*92*) and are given in column 2 of Table 5.4. The total mass of bone tissue in Reference Man is given as 5,500 g in page 52 of ICRP-70, and therefore, the mass of bone tissue in each of the 22 skeletal regions can be calculated (column 3, Table 5.4). Next, using the percentages of cortical mass of bone tissue and of trabecular mass of bone tissue for the different bone sites as given in Table 10 of the ICRP-70, one can calculate the mass of bone at a given skeletal site which is associated with its cortical or trabecular regions. Columns 4 and 5 of Table 5.4 give the mass percentage used for cortical and trabecular bone, and columns 6 and 7 of Table 5.4 give the resulting reference masses of cortical and trabecular bone tissue by skeletal site.

The calculations of reference masses for the endosteum in both cortical and trabecular bone are based on Tables 11 and 12 of ICRP-70, where surface-to-volume ratios (S/V) are given for several bone sites. When (S/V) ratios were not available, the ICRP-70 default values (page 23) were used: 3 mm^2 mm^{-3} for the cortical bone and 18 mm^2 mm^{c3} for the trabecular bone. Table 5.5 gives the values used for surface-to-volume ratios for both cortical and trabecular endosteum in the 22 cortical bone sites, respectively. To calculate the volume of endosteum, a thickness of 10 μm was assumed for the endosteum as recommended in ICRP Report 26 (*76*). The density of bone tissue was taken as 1.92 g cm^3 (adult cortical bone) and the density of endosteum as 1.03 g cm^3 (adult male average soft tissue) from Appendix A of the ICRU Report 46 (*81*). The various steps in calculating endosteum masses are shown in Table 5.5.

Table 5.6 summarizes the various reference masses presented in Table 5.3, Table 5.4, and Table 5.5 which are needed for the calculation of radionuclide S values by skeletal site within the adult. Bone tissue and endosteal masses are obtained directly from corresponding columns in Table 5.4 and Table 5.5, respectively. For the total marrow masses, columns 3 and 4 of Table 5.6 indicate the mass of total marrow space that is associated with either trabecular or cortical regions of a given skeletal site, respectively. More specifically, column 4 gives the mass of total marrow within the medullary cavities of the long bones of the appendicular skeleton (i.e., surrounded by cortical bone). Columns 5 and 6 of Table 5.6 indicate our attempt to partition the total marrow space for each site into its active and inactive marrow masses. For the humerii and femora, data on cellularity factors needed to make this partitioning are given only for their upper (proximal) and lower (distal) halves. Consequently, the CF values for the upper halves of these bones in the adult reflect both the portion of inactive marrow within the bone shaft and the fraction of partially active marrow contained within their proximal trabecular ends. As indicated in the footnotes to Table 5.6, we have attempted to approximate the distribution of active and inactive marrow in both the humeral and femoral shafts and in their trabecular ends using cellularity factors from neighboring trabecular bone sites. As noted in column 5, active marrow is only found in the proximal trabecular ends of the adult humerus and femur. At earlier ages, however, marrow with the medullary cavities is partially active (Table 40 of ICRP-70) and thus this distinction will be important in future extensions of the skeletal model to pediatric age groups.

The total skeletal mass of the active marrow, inactive marrow, marrow space, and bone tissue are consistent with Reference Man masses given in Table 47 of ICRP-70. The reference total surface area for adult cortical bone and trabecular bone are given in ICRP-70 (page 23) as 6.5 m^2 and 10.5 m^2, respectively. If one assumes a thickness of 10-μm for the endosteum (*76*) and a density of 1.03 g cm^{-3}, the approximate endosteal masses for cortical bone and trabecular bone are 67 g and 108 g, respectively. These values are fairly consistent with the calculated masses given in Table 5.6 (62.0 g and 89.9 g, respectively). The total calculated skeletal mass indicated in Table 5.6 is 9,305 g. A total reference skeletal mass of 10,500 g is given in Table 47 of ICRP 70, but this figure includes 1,100 g of cartilage and a total of 250 g for the combined masses of endosteum, teeth, periosteum, and blood vessels within the skeleton.

Results and Discussion

Twenty-two bone sites have been selected for the calculation of regional S values, and reference masses have been derived for all these bone sites for the marrow space, the active marrow, the inactive marrow, the bone matrix, and the endosteum considering both the cortical and trabecular regions of the skeleton. However, absorbed fractions of energy given by Bouchet et al. (*88*) and Bouchet and Bolch (*53*) have been calculated for only seven trabecular bone sites and three cortical bone sites for which chord length distributions are available. For trabecular bone sites, weighted combinations of these seven trabecular absorbed fractions are used as suggested by Whitwell (*67, 93*), Spiers (*67, 93*), and Dr. Keith Eckerman (ORNL, personal communication). Table 5.7 gives the percent weights for the absorbed fractions used for all 22 trabecular bone sites. For the cortical bone regions, the cortex of the femur, tibia, and humerus were considered in the calculations of absorbed fraction of energy within these bones (*53*). For the other cortical bone sites, the relatively small variations in absorbed fraction with bone site justified the use of average absorbed fraction to targets within cortical bone.

Using the absorbed fractions of energy from references *88* and *53* with the derived masses of Table 5.6, one can calculate bone site-specific S values to targets within trabecular bone and cortical bone. For trabecular bone, the source and target regions considered in the electron transport model are the TMS, the TBV, and the TBE (*88*). Consequently, S values can only be tabulated for these same source and target regions. In the same way, the source and target regions considered in the electron transport model in cortical bone are the CHS, the CBV, and the CBE (*53*).

It is also useful to derive a skeletal averaged S value using these site-specific S values. Here as well, only source and target regions considered in the transport model can be considered. The absorbed dose to a target T from emission within source S is given as the total energy deposited in T per unit mass of T. Therefore, for the case of the skeletal system, one can sum the energy deposited $\varepsilon_j(T \leftarrow S)$ in all 22 bone sites j, and divide by the total mass of target T in the skeleton $m_{skel,T}$:

$$D_{Skel}(T \leftarrow S) = \frac{\sum_{j}^{\text{All Bone Sites}} \varepsilon_j(T \leftarrow S)}{m_{Skel,T}} = \frac{\sum_{j}^{\text{All Bone Sites}} m_{j,T}\, D_j(T \leftarrow S)}{m_{Skel,T}}, \qquad \text{Eq. 5.1}$$

where $D_j(T \leftarrow S)$ is the dose to target T from source S in bone site j, and $m_{j,T}$ is the mass of T in bone site j. Therefore, by replacing the term $D_j(T \leftarrow S)$ within Equation 5.1 using the MIRD methodology of dose calculation (*1, 71*), one obtains the following expression:

$$D_{Skel}(T \leftarrow S) = \sum_{j}^{\text{All Bone Sites}} \omega_{j,T}\, \tilde{A}_{j,S}\, S_j(T \leftarrow S), \qquad \text{Eq. 5.2}$$

where $\omega_{j,T}$ is the relative mass fraction of target T in bone site j. If one now assumes that the activity in the source region is proportional to the volume (or mass) of the source, the cumulated activity in the source for bone site j is given as:

$$\tilde{A}_{j,S} = \frac{m_{j,S}}{m_{Skel,S}} \tilde{A}_{Skel,S}, \qquad \text{Eq. 5.3}$$

where $\tilde{A}_{Skel,S}$ is the cumulative activity in source S throughout the entire skeleton. Substituting Equation 5.3 into Equation 5.2, one obtains:

$$\begin{aligned} D_{skel}(T \leftarrow S) &= \sum_{j}^{\text{All Bone Sites}} \omega_{j,T}\, \omega_{j,S}\, \tilde{A}_{Skel,S}\, S_j(T \leftarrow S) \text{ or,} \\ D_{skel}(T \leftarrow S) &= \tilde{A}_{Skel,S} \sum_{j}^{\text{All Bone Sites}} \omega_{j,T}\, \omega_{j,S}\, S_j(T \leftarrow S), \end{aligned} \qquad \text{Eq. 5.4}$$

where $\omega_{j,S}$ is the relative mass fraction of source S in bone site j. Using the definition of the S values given by the MIRD Schema, one may relate the skeletal averaged dose to the skeletal averaged S value $S_{skel}(T \leftarrow S)$ as:

$$D_{Skel}(T \leftarrow S) = S_{Skel}(T \leftarrow S)\tilde{A}_{Skel,S}\,. \qquad \text{Eq. 5.5}$$

Finally, the skeletal averaged S value for a source region S, and target region T, is obtained through equating Equations 5.4 and 5.5:

$$S_{skel}(T \leftarrow S) = \sum_{j}^{\text{All Bone Sites}} \omega_{j,T}\, \omega_{j,S}\, S_j(T \leftarrow S) \qquad \text{Eq. 5.6}$$

The average S values to the skeleton for all source and target combinations are therefore calculated by using equation 5.6, where each bone site-specific S value is weighted by the mass fractions of both the source region S and the target region T associated with bone site j.

Consideration of the trabecular active marrow (TAM) as a source and/or target

In the adult, the marrow space within trabecular bone is composed of several different tissues including: (a) blood sinuses, blood vessels, and lymphatic vessels, (b) marrow tissue (marrow chords) containing the hematopoietic stem cells and their descendents within various stages of development, (c) connective tissue delineating the boundaries of the marrow chords and the adjacent sinuses, and (d) adipose cells. The endosteal cell layer then separates this marrow space from the adjacent bone trabeculae. Target tissues of interest to radiation dosimetry of the skeleton have been defined by the ICRP as the endosteum (both trabecular and cortical) and the active (or red) marrow. Although precise histological definitions of active (red) and inactive (yellow) marrow are lacking, one may consider the "active marrow" in the adult to be composed of all tissues within the marrow space exclusive of the adipose cells. Consequently, in many trabecular bone regions of the adult, the "active marrow" may be considered to be a spatial subset of the total volume of marrow space (total marrow tissue less the adipose tissue). This distinction is made here in that the computational models for electron transport in trabecular bone allow one to only make estimates of absorbed fractions for the marrow space as either the source or target region. Various assumptions must then be invoked when considering the active marrow as either the source or target.

Let us first consider the TAM as the radiation target only (i.e., not the radiation source). For a source within either the TBE or TBV, and noting that the location of the active marrow within the marrow space is unknown, one may assume that electron energy is uniformly deposited across the marrow space and thus the dose is uniform within that marrow space. Consequently, we have for bone site j:

$$S_j(\mathrm{TAM} \leftarrow \mathrm{S}) = S_j(\mathrm{TMS} \leftarrow \mathrm{S}), \qquad \text{Eq. 5.7}$$

where the source S may be either the TBE or the TBV. This expression is equivalent to that statement that the absorbed fraction for a TAM target and source S is equal to the computed value of absorbed fraction for a TMS target and source S weighted by the cellularity factor CF_j for bone site j:

$$\phi_j(\mathrm{TAM} \leftarrow \mathrm{S}) = CF_j\, \phi_j(\mathrm{TMS} \leftarrow \mathrm{S}). \qquad \text{Eq. 5.8}$$

In determining a skeletal averaged S value, one need consider only those bone sites containing active marrow (CF>0):

$$S_{skel}(TAM \leftarrow S) = \sum_{j}^{\substack{\text{All Bone Sites}\\ \text{with Active Marrow}}} \omega_{j,TAM}\, \omega_{j,S}\, S_j(TAM \leftarrow S). \qquad \text{Eq. 5.9}$$

Furthermore, if the radiation source is the full TMS, expressions 8 and 9 are equally valid for a TAM target.

Next, we consider the source region as the TAM and the target region as either the TMS, TBE, or TBE. Since we again have no geometrical information as to the location of the TAM within the TMS, one must assume that the TAM is uniformly distributed across the TMS and thus:

$$S_j(T \leftarrow TAM) = S_j(T \leftarrow TMS), \qquad \text{Eq. 5.10}$$

which is equivalent to equating the absorbed fractions from both TAM and TMS sources to these target regions:

$$\phi_j(T \leftarrow TAM) = \phi_j(T \leftarrow TMS). \qquad \text{Eq. 5.11}$$

Since the TAM is contained within the TMS, Equation 5.11 overestimates the true absorbed fraction for a TAM source. The overestimate is a function of the cellularity factor with the error becoming smaller with increasing values of CF (i.e., a larger portion of the marrow space is active and thus serving as a radiation source). Exact statements on the degree of error cannot be made in that the error is also a function of the spatial distribution of the TAM within the TMS (e.g., the TAM may be centrally or peripherally located within the TMS). To derive skeletal averaged S values, one should use a weighting factor (mass fraction) for the TAM as the source region:

$$S_{skel}(T \leftarrow TAM) = \sum_{j}^{\substack{\text{All Bone Sites}\\ \text{with Active Marrow}}} \omega_{j,T}\, \omega_{j,TAM}\, S_j(T \leftarrow TAM). \qquad \text{Eq. 5.12}$$

Finally, we consider the TAM as both the source and target. Here one may derive an overestimate of the S value by substituting for the absorbed fraction a corresponding value computed for a TMS source and target:

$$\phi_j(\mathrm{TAM} \leftarrow \mathrm{TAM}) = \phi_j(\mathrm{TMS} \leftarrow \mathrm{TMS}), \qquad \text{Eq. 5.13}$$

The S value for a TAM source and target is then conservatively estimated as:

$$S_j(\mathrm{TAM} \leftarrow \mathrm{TAM}) = \frac{m_{j,\mathrm{TMS}}}{m_{j,\mathrm{TAM}}} S_j(\mathrm{TMS} \leftarrow \mathrm{TMS}), \text{ or} \qquad \text{Eq. 5.14}$$

$$S_j(\mathrm{TAM} \leftarrow \mathrm{TAM}) = \frac{S_j(\mathrm{TMS} \leftarrow \mathrm{TMS})}{CF_j}, \qquad \text{Eq. 5.15}$$

where the CF_j is the cellularity factor for bone site j. At very low electron energies, Equation 5.13 is nearly exact in that the electrons emitted within either the TAM or the TMS have short ranges and thus the absorbed fraction approaches a value of unity with decreasing electron energy. With increasingly higher electron energies, a larger fraction of the electron energy may be deposited within the neighboring adipose cells of the marrow space (inactive marrow). Equation 5.13 then overestimates the true absorbed fraction in that a TMS source/target simulation does not account for this loss of particle energy. The degree of the overestimate will again be a function of the mass fraction of TAM within the TMS (i.e., the CF) and to some extent the spatial distribution of the TAM within the TMS. It is postulated that at very high electron energies, the magnitude of the overestimate will decrease as a greater fraction of the electron energy is deposited in the surrounding trabeculae and endosteal layers. To derive the corresponding skeletal averaged S value, one should use the weighting factor for the TAM as both source and target:

$$S_{skel}\left(\mathrm{TAM} \leftarrow \mathrm{TAM}\right) = \sum_{j}^{\substack{\text{All Bone Sites} \\ \text{with Active Marrow}}} \omega_{j,\mathrm{TAM}}\ \omega_{j,\mathrm{TAM}}\ S_j\left(\mathrm{TAM} \leftarrow \mathrm{TAM}\right). \qquad \text{Eq. 5.16}$$

Table 5.8 summarizes the different methodologies and assumptions in the calculations of absorbed fractions, bone site-specific S values, and skeletal averaged S values. In this same table, the equations used for these calculations are reproduced.

Tables of bone site-specific S values are given in Appendix G for trabecular bone, and in Appendix H for cortical bone. Ten beta-emitting radionuclides are considered with radiation characteristics given in Table 5.9. For trabecular bone, source and target regions considered are the TMS, TBE, TBV, and TAM. Note that S values for the TAM are only approximate since the TAM could not be considered explicitly in the transport model (*88*). For cortical bone, source regions are the CHS, CBE, and CBV, and target regions are the CBE and CBV (*53*). Some of these radionuclides emit gamma-rays and x-rays, but with corresponding mean energies emitted per nuclear transition which are generally small compared to the beta particle component (an exception is ^{117m}Sn where these components are comparable).

Skeletal averaged S values were subsequently calculated for all source and target combinations, and are given in Table 5.10 for all ten radionuclides. Since masses were not available for the CHS, it was assumed that the volume of tissue within the Haversian canal space was proportional to the volume of cortical bone. In determining skeletal average S values for CHS sources, the mass fractions of cortical bone were used in the weighting expressions.

Comparison of skeletal S values with previous calculations

It is interesting to compare our calculated skeletal averaged S values with those currently used in clinical medicine. Table 5.11 gives the different skeletal averaged S values that we were able to sort from the MIRD 11, MIRDOSE2, and MIRDOSE3 data sets for two beta emitters: ^{32}P and ^{90}Y.

When the TAM is considered as both the source and target region, our calculated S values are larger than those given in MIRD 11 and by MIRDOSE3, yet are smaller than those given by MIRDOSE2. Differences between the MIRD 11 S values and our values are attributed to the large change in the reference mass for the active marrow from 1,500 g to 1,170 g. If an active marrow mass of 1,170 g is used instead of 1,500 g in the MIRD 11 S values, differences of less than 10% are seen between both sets. Differences between our values and those of the MIRDOSE2 program (ratios of 0.68 and 0.67 for ^{32}P and ^{90}Y, respectively) are mainly due to differences in the underlying models for the absorbed fraction. An absorbed fraction of unity is assumed within MIRDOSE2 for a TAM source and target, while our values obtained from three-dimensional transport decrease with increasing particle energy (see Figure 8 of Reference *88*).

Differences between our values and those of MIRDOSE3 may come from several sources: (a) reference masses for active marrow, (b) absorbed fraction values (one-dimensional versus three-dimensional transport), and (c) weighting schemes for obtaining site-specific and skeletal averaged S values. By using both a reference mass of 1,120 g for the active marrow in the adult and absorbed fractions obtained from a one-dimensional transport model similar to that constructed by Eckerman (*74*), differences in methodology can be isolated to differences in the weighting schemes employed. Using data for ^{32}P and ^{90}Y, very good agreement was found between MIRDOSE3 skeletal averaged S values (4.41 x 10^{-5} and 5.87 x 10^{-5} mGy MBq^{-1} s^{-1}, respectively) and those obtained using our one-dimensional model data and the following weighting scheme:

$$S_{\text{skel}}(\text{TAM} \leftarrow \text{TAM}) = \sum_{j}^{\substack{\text{All Bone Sites} \\ \text{with Active Marrow}}} \omega_{j,\text{TAM}}\ \omega_{j,\text{TAM}}\ S_j(\text{TMS} \leftarrow \text{TMS}), \qquad \text{Eq. 5.17}$$

(4.54 x 10^{-5} and 6.07 x 10^{5} mGy MBq^{-1} s^{-1}, respectively). In comparing the weighting scheme of MIRDOSE3 (Equation 5.17) to the one used in our model (Equation 5.16), we note that MIRDOSE3 implicitly assumes that the absorbed fraction for a TAM source and target is equal to that for a TMS times the cellularity factor:

$$\phi_j(\text{TAM} \leftarrow \text{TAM}) = \text{CF}_j\ \phi_j(\text{TMS} \leftarrow \text{TMS}) \qquad \text{Eq. 5.18}$$

This approximation (Equation 5.18) greatly underestimates the absorbed fraction, particularly at low energies where the absorbed fraction should approach unity for a TAM source and target.

Other comparisons for TAM targets and TBE or TBV sources show that the new S values are ~12% lower than those from MIRDOSE3 due primarily to the consideration of the marrow space as the marrow cavity minus its endosteal layers in the present model. MIRDOSE3 does not make this distinction. The large difference between our S values and those of MIRDOSE2 may be traced to the use of the ICRP-30 bone model within MIRDOSE2. Here, MIRDOSE2 assigns both ^{32}P and ^{90}Y as surface-seekers in that their physical half-lives are less than 15 days. An energy-independent absorbed fraction of 0.5

is thus used in MIRDOSE2. Finally, one can note that the dose contribution from the CBV to the TAM is assumed to be equal to zero for all models except that in MIRD-11.

When one considers the bone endosteum (both cortical and trabecular) as target region, one calculates higher S values using the new model. The absorbed fraction values to the TBE were seen to be higher in the new model for all sources than in the model used in MIRDOSE3 (*88*). These increases occur even though the total mass of endosteum increased from 120 g to 155 g. For cases when cortical bone is the source region, no information is available about the model used within the MIRDOSE3 program.

The last possible comparison is for the bone volume as the target. Only in MIRD-11 are S values given for a bone volume target. Very good agreement is seen when the TAM or the CBV are source regions, and in these cases, the differences come mainly from the change in the reference mass for bone from 5,000 g in MIRD-11 to 5,500 g in both ICRP-70 and the new model. In the case of a TBV source, MIRD-11 assumes that for a TBV source all the energy was deposited in the TAM and TBV. Since it was seen (Figure 8 of reference *88*) that the reference absorbed fraction used in ICRP-30 for a TBV source and a TMS target greatly underestimated the absorbed fraction for electron energies greater than 200 keV (except in the parietal bone), the remaining absorbed fraction greatly overestimates the absorbed fraction to the TBV. This is why the MIRD-11 calculated absorbed fractions are seen to be higher for a TBV source and a BV target than predicted in our newly calculated S values. The MIRD-11 absorbed fractions for this source-target combination were further verified by assuming an absorbed fraction of 0.65 in the TBV (remainder of the 0.35 absorbed fraction to the TAM given in ICRP-30), and in so doing close agreement was found (recalculated S values of 1.50 x 10^{-5} mGy MBq^{-1} s^{-1} for ^{32}P and 2.03 x 10^{-5} mGy MBq^{-1} s^{-1} for ^{90}Y).

Summary and Conclusions

New skeletal S values have been derived based on two new three dimensional electron transport models in trabecular and cortical bone (*53, 88*), and on new reference masses derived from ICRP Publication 70 (*25*). These S values are tabulated for 22 different bone sites within the human skeletal system. A skeletal averaged S value is also given based on these 22 site-specific S values. Source and target regions considered for the tabulation of S values correspond to the source and target considered in the electron transport model: the TMS, TBE, TBV for the trabecular bone sites, and the CHS, CBE, and CBV for the cortical bone sites. S values for the TAM as a source and target region were also estimated. Since the location of the TAM within the marrow space is not known, various assumptions were used. In the case of the TAM as a target region, it was assumed that the energy was uniformly distributed across the entire marrow space. For the case of a TAM source region, results of absorbed fractions to the TMS were used in the calculations of S values, giving an overestimate of the true S value. This overestimate is a function of the cellularity factor of the trabecular bone site considered, and will be greater for bone sites with small cellularity factors.

Comparisons between the new calculated S values with other published data show that a greater number of source and target combinations are considered in the new model. A difference in methodology was also seen with the MIRDOSE3 data for the TAM as a source and target which underestimates the S value to the TAM particularly at low energies. Other differences were attributed to more accurate electron transport models in trabecular bone and cortical bone, and newer reference masses.

Limitations of these calculated S values can be separated in two different components. First, the calculated absorbed fractions are limited by their respective transport models, which are in turn limited by the information embedded within the measured chord length distributions. Secondly, reference masses are sometimes based on very old measurements, and on persons who were sometimes not representative of the average population. Furthermore, the populations in which these S values may be used do not represent the average population, but a population with generally a very low marrow reserve due to previous chemotherapy treatments. In these cases, patient-specific skeletal dosimetry would give improved correlations between calculated doses and marrow toxicity effects. Techniques needed to calculate patient-specific skeletal S values, however, are currently unavailable. Instead, current efforts have been devoted to making patient-specific estimates of source activity (*50, 51, 94-96*) while using reference S values from either MIRD-11, MIRDOSE2, or MIRDOSE3. Some of these activity quantification techniques attempt to estimate an activity concentration within the active marrow source. If patient-specific marrow masses are not available, reference masses are then utilized to provide estimates of total skeletal activity $A_{skel,S}$ as defined and used earlier in Equation 5.3. In this case, it is important that these reference masses be consistent with those used in the determination of both site-specific and skeletal averaged S values. Furthermore, it is important that these reference masses be fully documented and referenced.

Future extensions of the S value model presented here would include the contribution of cross irradiation between source and targets in trabecular and cortical bone regions of the various skeletal sites. This cross irradiation can be important for high electron energies, and for thin cortical bone shells. The MIRD 11 S value calculations were the only data set considering such cross irradiation and were done so using rather simplistic geometrical models (slabs, spherical shells, etc.). Cross irradiation from cortical to trabecular bone and vice versa is difficult to model in that geometrical macroscopic models for each of the 22 bone sites would need to be developed. If such models were available, they could additionally be used to estimate intraskeletal absorbed fractions for photon sources within the skeleton.

In spite of these limitations, the S values presented in this chapter will allow for better estimates of the dose to the skeletal system. If regional skeletal activity concentration is available, it is advisable to use the tabulated bone site-specific S values rather than the skeletal averaged S values due to the large variations in these bone site-specific S values.

Table 5.1: Methods for deriving absorbed fractions used in the ORNL-5000 / MIRD-11 S value calculations, in the ICRP-30 and MIRDOSE2 bone models, and in the MIRDOSE3 bone model. Source and target regions considered are trabecular bone (TB), red marrow (RM), yellow marrow (YM), cortical bone (CB), trabecular bone surface (TBS), and cortical bone surface (CBS), where the latter two represent the endosteal layers of these two bone types.

Target	**Source**	**ORNL-5000 / MIRD-11**	**ICRP-30 / MD2**	**MD3**
RM	TB	Derived from Spiers (*67, 68*)	0.35	From Reference *74*
YM	TB	0.0		
BS	TB	Derived from Spiers (*67, 68*)	0.025	From Reference *74*
TB	TB	Use: $\phi(\text{TB}\leftarrow\text{TB}) + \phi(\text{RM}\leftarrow\text{TB}) = 1.0$		
CB	TB	0.0		
RM	RM	Assume uniform energy deposited per gram	1.0	From Reference *74*
YM	RM	0.0		
TBS	RM	Use $\phi(\text{TBS}\leftarrow\text{TB})$		
CBS	RM	0.0		
BS	RM	Assume uniform energy deposited per gram and assume $\phi(\text{CBS}\leftarrow\text{RM})=0$	0.02‡	From Reference *74*
TB	RM	Use reciprocity theorem		
CB	RM	0.0		
RM	YM	0.0		
YM	YM	1.0		
TBS	YM	0.0		
CBS	YM	Use: $\Phi(\text{CBS} \leftarrow \text{YM}) = \Phi(\text{YM} \leftarrow \text{YM})/2$		
TB	YM	0.0		
CB	YM	0.0		
RM	CB	Derived from Spiers (*67, 68*)	0.0	Assume 0.0
YM	CB	0.0		
BS	CB	Derived from Spiers (*67, 68*)	0.015	No published model
TB	CB	0.0		
CB	CB	1.0		
RM	TBS	Not Calculated	0.5	
BS	TBS		0.25* (0.025)†	
RM	CBS	Not Calculated	0.0	Assume 0.0
BS	CBS		0.25* (0.015)†	No published model

* $\bar{E}_\beta \le 0.2\,\text{MeV}$

† $\bar{E}_\beta \ge 0.2\,\text{MeV}$

‡ An absorbed fraction of 0.02 is calculated from the ICRP recommendation: $\Phi(\text{BS} \leftarrow \text{RM}) = \Phi(\text{RM} \leftarrow \text{RM})/2$ (*72*).

Table 5.2: List of bone sites used for the calculations of S values

Region	**Bone sites**
Head	1: Cranium
	2:Mandible
Vertebra	3: Cervical
	4: Thoracic
	5: Lumbar
Ribs, Sternum, Shoulders	6: Sternum
	7: Ribs
	8: Scapulae
	9: Clavicles
Pelvis	10: Os coxae
	11: Sacrum
Arms	12: Humerii, upper half[*]
	13: Humerii, lower half[†]
	14: Radii
	15: Ulna
	16: Wrist and hands
Legs	17: Femura, upper half[*]
	18: Femura, lower half[†]
	19: Patella
	20: Tibia
	21: Fibula
	22: Ankles and feet

*Proximal epiphysis and proximal half of the diaphysis

†Distal epiphysis and distal half of the diaphysis

Table 5.3: Derivation of reference masses for active marrow (AM), marrow space (MS), and inactive marrow (IM) in the adult human skeletal system, and verification against values obtained using the cellularity factor (CF).

Skeletal Site	% AM	Mass AM (g)	% Total MS	Mass Total MS (g)	Mass IM (g)	Computed CF	CF	CF
	ICRP-70, Table 40, age 40	*%AM × 1,170 g*	*ICRP-23, Table 30*	*%MS × 3,650 g*	*Total - Active*	Active Marrow / Total Marrow	ICRP-70, Table 41, age 25	ICRP-70, Table 41, age 40
HEAD								
Cranium	7.6	89.0	6.3	231.2	142.2	0.39	0.42	0.38
Mandible	0.8	9.4	0.6	21.9	12.5	0.43	0.42	0.38
VERTEBRA								
Cervical Vert.	3.9	45.7	1.8	65.0	19.3	0.70	0.72	0.70
Thoracic Vert.	16.1	188.6	7.3	266.2	77.7	0.71	0.72	0.70
Lumbar Vert.	12.3	144.1	5.6	204.9	60.8	0.70	0.72	0.70
RIBS, STERNUM, SHOULDERS								
Sternum	3.1	36.3	1.4	50.4	14.1	0.72	0.72	0.70
Ribs	16.1	188.6	7.3	268.0	79.5	0.70	0.72	0.70
Scapulae	2.8	32.8	2.4	86.9	54.1	0.38	0.42	0.38
Clavicles	0.8	9.4	0.8	27.8	18.4	0.34	0.37	0.33
PELVIS								
Os Coxae	17.5	205.0	10.4*	379.7	174.8	0.54	0.58	0.48
Sacrum	9.9	115.9	5.9*	214.8	98.9	0.54	0.58	0.48
ARMS								
Humerii, upper half	2.3	26.9	3.0†	109.2	82.3	0.25	0.30	0.25
Humerii, lower half	0.0	0.0	3.0†	109.2	109.2	0.00	0.00	0.00
Radii	0.0	0.0	1.3	48.9	48.9	0.00	0.00	0.00
Ulna	0.0	0.0	1.4	50.4	50.4	0.00	0.00	0.00
Wrist and Hands	0.0	0.0	2.7	100.1	100.1	0.00	0.00	0.00
LEGS								
Femura, upper half	6.7	78.5	8.5‡	311.5	233.0	0.25	0.30	0.25
Femura, lower half	0.0	0.0	8.5‡	311.5	311.5	0.00	0.00	0.00
Patella	0.0	0.0	0.8	29.9	29.9	0.00	0.00	0.00
Tibia	0.0	0.0	10.9	398.8	398.8	0.00	0.00	0.00
Fibula	0.0	0.0	1.5	56.2	56.2	0.00	0.00	0.00
Ankles and Feet	0.0	0.0	8.4	307.5	307.5	0.00	0.00	0.00
Total mass (g)	99.9	1170.0	100.0	3650.0	2480.0			

*For the os coxae and sacrum, the %MS was derived from the %MS in the pelvis (16.28%) by partitioning this value for each bone using their relative fractions of AM

†Assumed half of the % MS in the full humerus (5.98%)

‡Assumed half of the % MS in the full femur (17.06%)

Table 5.4: Derivation of reference masses of cortical and trabecular bone matrix in the human skeletal system.

Skeletal Site	**% mass of total dry skeleton**	**Bone mass (g)**	**% Cortical**	**% Trabecular**	**Cortical mass of bone matrix (g)**	**Trabecular mass of bone matrix (g)**
	ICRP-70, Table 8	*% skeleton × 5,500g*	*ICRP-70, Table 10*	*ICRP-70, Table 10*	*Bone Mass × %Cort.*	*Bone Mass × %Trab.*
HEAD			*From reference 97*			
Cranium	15.7	865.2	95[‡]	5[‡]	822.0	43.3
Mandible	1.6	88.2	95[‡]	5[‡]	83.8	4.4
VERTEBRA			*From reference 97*			
Cervical Vert.	1.5	82.7	25	75	20.7	62.0
Thoracic Vert.	3.8	209.4	25	75	52.4	157.1
Lumbar Vert.	3.2	176.4	34	66	60.0	116.4
RIBS, STERNUM, SHOULDERS			*From reference 97*			
Sternum	0.5	27.6	94	6	25.9	1.7
Ribs	6.0	330.7	94	6	310.8	19.8
Scapulae	3.1	170.8	94	6	160.6	10.3
Clavicles	1.0	55.1	94	6	51.8	3.3
PELVIS						
Os Coxae	8.3	457.4	90[§]	10[§]	411.7	45.7
Sacrum	1.9	104.7	75	25	78.5	26.2
ARMS			*From reference 98 & 97 for hands*			
Humerii, upper half	3.4[*]	187.4	90[*]	10[*]	168.6	18.7
Humerii, lower half	3.4[*]	187.4	90[*]	10[*]	168.6	18.7
Radii	2.3	126.8	87	13	110.3	16.5
Ulna	2.9	159.8	87	13	139.0	20.8
Wrist and Hands	2.6	143.3	95	5	136.1	7.2
LEGS			*From reference 98 & 97 for feet*			
Femura, upper half	9.5[*]	523.5	77[*]	23[*]	403.1	120.4
Femura, lower half	9.5[*]	523.5	77[*]	23[*]	403.1	120.4
Patella	0.6	33.1	80[†]	20[†]	26.5	6.6
Tibia	11.1	611.7	83	17	507.7	104.0
Fibula	2.3	126.8	89	11	112.8	13.9
Ankles and Feet	5.6	308.6	95	5	293.2	15.4
Total mass (g)		**5500.0**			**4547.2**	**952.8**

[*] The % mass of total dry skeleton is assumed to be equally distributed in the upper and lower halves of the humerii and femora

[†] The default reference value given in ICRP-70 page 20 is used (*25*)

[‡] Indicated as "skull" in Table 10 of ICRP-70 (*25*)

[§] Indicated as "inominate" in Table 10 of ICRP-70 (*25*)

Table 5.5: Derivation of masses of endosteum in the cortical and trabecular bones with the adult human skeleton.

Skeletal Site	CORTICAL BONE (S/V) (mm²/mm³)	Bone matrix (g)	Bone matrix (cm³)	Endosteum (cm³)	Endosteum (g)	TRABECULAR BONE (S/V) (mm²/mm³)	Bone matrix (g)	Bone matrix (cm³)	Endosteum (cm³)	Endosteum (g)
	ICRP-70, Table 11	*Mass × % cort.*	*Mass / 1.92 g cm^{-3}*	*Vol. × (S/V) × 10 μm*	*Vol × 1.03 g cm^{-3}*	*ICRP-70, Table 12*	*Mass × %Trab.*	*Mass / 1.92 g cm^{-3}*	*Vol. × (S/V) × 10 μm*	*Vol × 1.03 g cm^{-3}*
HEAD										
Cranium	3.0*	822.0	428.1	12.8	13.2	7.8†	43.3	22.5	1.8	1.8
Mandible	3.0*	83.8	43.6	1.3	1.3	7.8†	4.4	2.3	0.2	0.2
VERTEBRA										
Cervical Vert.	3.0*	20.7	10.8	0.3	0.3	18.0*	62.0	32.3	5.8	6.0
Thoracic Vert.	3.0*	52.4	27.3	0.8	0.8	18.0*	157.1	81.8	14.7	15.2
Lumbar Vert.	3.0*	60.0	31.2	0.9	1.0	19.7†	116.4	60.6	11.9	12.3
RIBS, STERNUM, SHOULDERS										
Sternum	3.0*	25.9	13.5	0.4	0.4	18.5†¶	1.7	0.9	0.2	0.2
Ribs	3.0*	310.8	161.9	4.9	5.0	18.5†	19.8	10.3	1.9	2.0
Scapulae	3.0*	160.6	83.6	2.5	2.6	18.5†¶	10.3	5.3	1.0	1.0
Clavicles	3.0*	51.8	27.0	0.8	0.8	18.5†¶	3.3	1.7	0.3	0.3
PELVIS										
Os Coxae	3.0*	411.7	214.4	6.4	6.6	17.2†	45.74	23.8	4.1	4.2
Sacrum	3.0*	78.5	40.9	1.2	1.3	19.7$^{\dagger **}$	26.18	13.6	2.7	2.8
ARMS										
Humerii, upper half	2.3†	168.6	87.8	2.0	2.1	18.0*	18.7	9.8	1.8	1.8
Humerii, lower half	2.3†	168.6	87.8	2.0	2.1	18.0*	18.7	9.8	1.8	1.8
Radii	2.3†‡	110.3	57.4	1.3	1.4	18.0*	16.5	8.6	1.5	1.6
Ulna	2.3†‡	139.0	72.4	1.7	1.7	18.0*	20.8	10.8	1.9	2.0
Wrist and Hands	2.3†‡	136.1	70.9	1.6	1.7	18.0*	7.2	3.7	0.7	0.7
LEGS										
Femora, upper half	2.9†	403.1	210.0	6.1	6.3	17.3†	120.4	62.7	10.8	11.2
Femora, lower half	2.9†	403.1	210.0	6.1	6.3	17.3†	120.4	62.7	10.8	11.2
Patella	3.0*	26.5	13.8	0.4	0.4	18.0*	6.6	3.4	0.6	0.6
Tibia	1.9†	507.7	264.4	5.0	5.2	18.0*	104.0	54.2	9.7	10.0
Fibula	1.9†§	112.8	58.8	1.1	1.1	18.0*	13.9	7.3	1.3	1.3
Ankles and Feet	3.0*	293.2	152.7	4.6	4.7	18.0*	15.4	8.0	1.4	1.5
Total mass (g)		**4547.2**			**65.6**		**952.8**			**89.7**

* Default reference value from ICRP-70 page 23 (*25*)

†Data from Beddoe (*54, 55, 86*)

‡Assumed to equal that for the humerii

§ Assumed to equal that for the tibia

¶ Assumed to equal that for the ribs

** Assumed to equal that for the lumbar vertebra

Table 5.6: Summary of the reference masses derived for the calculation of regional S values within the adult skeleton.

Skeletal Site	Marrow Mass (g) Total	Total MS assoc. w/ TB	Total MS assoc. w/ CB	Active marrow (TB)	Inactive Marrow	Bone Tissue Mass (g) Cort.	Trab.	Endosteum Mass (g) Cort.	Trab.
HEAD									
Cranium	231.2	231.2	0.0	89.0	142.2	822.0	43.3	13.2	1.8
Mandible	21.9	21.9	0.0	9.4	12.5	83.8	4.4	1.3	0.2
VERTEBRA									
Cervical Vert.	65.0	65.0	0.0	45.7	19.3	20.7	62.0	0.3	6.0
Thoracic Vert.	266.2	266.2	0.0	188.6	77.7	52.4	157.1	0.8	15.2
Lumbar Vert.	204.9	204.9	0.0	144.1	60.8	60.0	116.4	1.0	12.3
RIBS, STERNUM, SHOULDERS									
Sternum	50.4	50.4	0.0	36.3	14.1	25.9	1.7	0.4	0.2
Ribs	268.0	268.0	0.0	188.6	79.5	310.8	19.8	5.0	2.0
Scapulae	86.9	86.9	0.0	32.8	54.1	160.6	10.3	2.6	1.0
Clavicles	27.8	27.8	0.0	9.4	18.4	51.8	3.3	0.8	0.3
PELVIS									
Os Coxae	379.7	379.7	0.0	205.0	174.8	411.7	45.7	6.6	4.2
Sacrum	214.8	214.8	0.0	115.9	98.9	78.5	26.2	1.3	2.8
ARMS									
Humerii, upper half	109.2	67.3[*]	41.8	26.9	82.3	168.6	18.7	2.1	1.8
Humerii, lower half	109.2	67.3[*]	41.8	0.0	109.2	168.6	18.7	2.1	1.8
Radii	48.9	29.4[†]	19.6	0.0	48.9	110.3	16.5	1.4	1.6
Ulna	50.4	30.2[†]	20.2	0.0	50.4	139.0	20.8	1.7	2.0
Wrist and Hands	100.1	100.1	0.0	0.0	100.1	136.1	7.2	1.7	0.7
LEGS									
Femora, upper half	311.5	156.9[*]	154.6	78.5	233.0	403.1	120.4	6.3	11.2
Femora, lower half	311.5	156.9[*]	154.6	0.0	311.5	403.1	120.4	6.3	11.2
Patella	29.9	29.9	0.0	0.0	29.9	26.5	6.6	0.4	0.6
Tibia	398.8	199.4[‡]	199.4	0.0	398.8	507.7	104.0	5.2	10.0
Fibula	56.2	28.1[‡]	28.1	0.0	56.2	112.8	13.9	1.1	1.3
Ankles and Feet	307.5	307.5	0.0	0.0	307.5	293.2	15.4	4.7	1.5
Total mass (g)	**3650.0**	**2989.9**	**660.1**	**1170.0**	**2480.0**	**4547.2**	**952.8**	**65.6**	**89.7**

[*] In order to assign marrow masses associated with only the marrow contained within the trabecular regions of the epiphyses, we have assumed a CF of 0.4 for the proximal ends of the humerii (same as the scapulae and clavicles) and a CF of 0.5 for the proximal ends of the femora (same as the os coxae and sacrum). For example, the mass of marrow space associated with distal trabecular regions of the humerii is estimated as (26.9 g active marrow / 0.4) = 67.3 g total marrow. The remaining 41.8 g of marrow space within the diaphyses is obtained by subtraction (109.2 g - 67.3 g) = 41.8 g.

[†] Distributions of trabecular MS and cortical MS in both the radii and ulna are assumed to be 60% and 40%, respectively, based on their fractional distribution within the humerus

[‡] Distributions of trabecular MS and cortical MS in both the tibia and fibula are assumed to be 50% and 50%, respectively, based on their fractional distribution within the femur

Table 5.7: Weights used for the derivation of bone site-specific absorbed fractions for trabecular bone based on the absorbed fractions of energy given in Bouchet et al. (*88*) for seven bone sites: cervical vertebrae (CV), femur head (FH), femur neck (FN), iliac crest (IC), lumbar vertebrae (LV), parietal bone (PB), and rib bones (RB).

Skeletal Site	**CV**	**FH**	**FN**	**IC**	**LV**	**PB**	**RB**
HEAD							
Cranium						100 %	
Mandible						100 %	
VERTEBRA							
Cervical Vert.	100 %						
Thoracic Vert.	50%				50%		
Lumbar Vert.					100 %		
RIBS, STERNUM, SHOULDERS							
Sternum							100%
Ribs							100%
Scapulae				60%	40%		
Clavicles				60%	40%		
PELVIS							
Os Coxae				60%	40%		
Sacrum				60%	40%		
ARMS							
Humerii, upper half		80%	20%				
Humerii, lower half		50%	50%				
Radii		50%	50%				
Ulna		50%	50%				
Hands		50%	50%				
LEGS							
Femura, upper half		80%	20%				
Femura, lower half		50%	50%				
Patella		50%	50%				
Tibia		50%	50%				
Fibula		50%	50%				
Feet		50%	50%				

Table 5.8: Summary of the calculations of bone site-specific absorbed fractions and S values, and skeletal averaged S values for the various source and target combinations.

Sources	**Targets**	**Absorbed fractions: ϕ**	**Bone site-specific S values: S_j**	**Skeletal Averaged S values: S_{skel}**
TMS **TBE** **TBV** **CHS** **CBE** **CBV**	**TMS** **TBE** **TBV** **CHS** **CBE** **CBV**	Derived directly from the transport models	Use corresponding ϕ	Calculated using mass weighting $S_{skel}(T \leftarrow S) = \sum_{j}^{\text{All Bone Sites}} \omega_{j,T}\omega_{j,S}\, S_j(T \leftarrow S)$
TMS **TBE** **TBV**	**TAM**	Assume uniform energy deposited across the TMS: $\phi_j(TAM \leftarrow S) = CF_j\ \phi_j(TMS \leftarrow S)$	Use corresponding ϕ $S_j(TAM \leftarrow S) = S_j(TMS \leftarrow S)$	Calculated using mass weighting $S_{skel}(TAM \leftarrow S) = \sum_{j}^{\text{All Bone Sites with Active Marrow}} \omega_{j,TAM}\omega_{j,S}\, S_j(TAM \leftarrow S)$
TAM	**TMS** **TBE** **TBV**	Use ϕ results for the TMS as a source: $\phi_j(T \leftarrow TAM) = \phi_j(T \leftarrow TMS)$	Use corresponding ϕ $S_j(T \leftarrow TAM) = S_j(T \leftarrow TMS)$	Calculated using mass weighting $S_{skel}(T \leftarrow TAM) = \sum_{j}^{\text{All Bone Sites with Active Marrow}} \omega_{j,T}\omega_{j,TAM}\, S_j(T \leftarrow TAM)$
TAM	**TAM**	Use ϕ results for the TMS as both source and target: $\phi_j(TAM \leftarrow TAM) = \phi_j(TMS \leftarrow TMS)$	Use corresponding ϕ $S_j(TAM \leftarrow TAM) = \dfrac{S_j(TMS \leftarrow TMS)}{CF_j}$	Calculated using mass weighting $S_{skel}(TAM \leftarrow TAM) = \sum_{j}^{\text{All Bone Sites with Active Marrow}} \omega_{j,TAM}\omega_{j,TAM}\, S_j(TAM \leftarrow TAM)$

* S values for the cortical haversian space (CHS) as a target regions are not give due to a lack of available data to derive corresponding reference masses.

Table 5.9: Radiation characteristics of the radionuclides used for the calculation of S values.

	Mode of decay	**Avg. Energy (MeV)**†	**Max. Energy (MeV)**†	**Half-life (days)**†	**Δ (electron) (mGy g MBq^{-1} s^{-1})***	**Δ (photon) (mGy g MBq^{-1} s^{-1})***
^{32}P	β-	0.695	1.710	14.3	1.16E-01	0.00E+00
^{33}P	β-	0.077	0.249	25.3	1.28E-02	0.00E+00
^{89}Sr	β-	0.583	1.492	50.5	9.74E-02	1.35E-05
^{90}Sr	β-	0.196	0.546	10,416	3.30E-02	0.00E+00
^{90}Y	β-	0.934	2.282	2.67	1.56E-01	2.70E-07
^{117m}Sn	I.T.	0.135	0.159	13.6	2.58E-02	2.53E-02
^{153}Sm	β-	0.225	0.809	1.95	4.50E-02	9.91E-03
^{169}Er	β-	0.100	0.351	9.40	1.74E-02	1.52E-06
^{177}Lu	β-	0.133	0.498	6.71	2.46E-02	5.61E-03
^{186}Re	β- and E.C.	0.323	1.075	3.78	5.76E-02	3.29E-03

* From reference *99*.

† From reference *100*.

Table 5.10: Skeletal averaged S values (mGy MBq^{-1} s^{-1}) for the different combinations of source and target regions for both the trabecular and cortical bone.

Skeletal Region	^{32}**P**	^{33}**P**	^{89}**Sr**	^{90}**Sr**	^{90}**Y**	^{117m}**Sn**	^{153}**Sm**	^{169}**Er**	^{177}**Lu**	^{186}**Re**
S_{skel}(TAM←TAM)	6.74E-05	9.63E-06	5.71E-05	2.14E-05	8.99E-05	1.89E-05	3.01E-05	1.25E-05	1.71E-05	3.57E-05
S_{skel}(TMS←TAM)	2.64E-05	3.77E-06	2.24E-05	8.37E-06	3.52E-05	7.40E-06	1.18E-05	4.90E-06	6.68E-06	1.40E-05
S_{skel}(TBE←TAM)	5.55E-05	3.65E-06	4.61E-05	1.29E-05	7.60E-05	7.91E-06	1.69E-05	5.37E-06	8.58E-06	2.54E-05
S_{skel}(TBV←TAM)	3.30E-05	1.26E-06	2.71E-05	6.71E-06	4.58E-05	3.07E-06	8.52E-06	2.24E-06	3.96E-06	1.42E-05
S_{skel}(TAM←TMS)	2.65E-05	3.78E-06	2.25E-05	8.40E-06	3.54E-05	7.42E-06	1.18E-05	4.92E-06	6.70E-06	1.40E-05
S_{skel}(TMS←TMS)	2.65E-05	3.78E-06	2.25E-05	8.40E-06	3.54E-05	7.42E-06	1.18E-05	4.92E-06	6.70E-06	1.40E-05
S_{skel}(TBE←TMS)	5.46E-05	3.54E-06	4.53E-05	1.26E-05	7.47E-05	7.68E-06	1.66E-05	5.21E-06	8.35E-06	2.49E-05
S_{skel}(TBV←TMS)	3.26E-05	1.24E-06	2.68E-05	6.63E-06	4.52E-05	3.01E-06	8.42E-06	2.20E-06	3.91E-06	1.40E-05
S_{skel}(TAM←TBE)	2.52E-05	1.88E-06	2.09E-05	6.16E-06	3.44E-05	4.00E-06	8.09E-06	2.69E-06	4.20E-06	1.17E-05
S_{skel}(TMS←TBE)	2.52E-05	1.88E-06	2.09E-05	6.16E-06	3.44E-05	4.00E-06	8.09E-06	2.69E-06	4.20E-06	1.17E-05
S_{skel}(TBE←TBE)	6.70E-05	2.34E-05	5.85E-05	2.96E-05	8.66E-05	3.47E-05	5.84E-05	2.98E-05	3.10E-05	4.37E-05
S_{skel}(TBV←TBE)	3.56E-05	5.31E-06	3.03E-05	1.20E-05	4.70E-05	1.09E-05	1.60E-05	6.78E-06	9.56E-06	1.94E-05
S_{skel}(TAM←TBV)	2.33E-05	8.32E-07	1.92E-05	4.62E-06	3.25E-05	2.03E-06	5.90E-06	1.50E-06	2.70E-06	9.94E-06
S_{skel}(TMS←TBV)	2.33E-05	8.32E-07	1.92E-05	4.62E-06	3.25E-05	2.03E-06	5.90E-06	1.50E-06	2.70E-06	9.94E-06
S_{skel}(TBE←TBV)	6.14E-05	6.99E-06	5.20E-05	1.88E-05	8.15E-05	1.50E-05	2.43E-05	9.47E-06	1.39E-05	3.18E-05
S_{skel}(TBV←TBV)	4.19E-05	1.02E-05	3.66E-05	1.79E-05	5.36E-05	1.92E-05	2.63E-05	1.25E-05	1.59E-05	2.62E-05
S_{skel}(CBE←CHS)	9.53E-05	1.82E-05	8.61E-05	4.33E-05	1.05E-04	4.05E-05	5.39E-05	2.42E-05	3.41E-05	6.34E-05
S_{skel}(CBV←CHS)	1.76E-05	3.64E-07	1.40E-05	2.67E-06	2.64E-05	8.98E-07	3.52E-06	7.29E-07	1.44E-06	6.52E-06
S_{skel}(CBE←CBE)	5.46E-05	2.98E-05	4.93E-05	3.18E-05	6.73E-05	4.27E-05	6.88E-05	3.74E-05	3.69E-05	4.30E-05
S_{skel}(CBV←CBE)	2.38E-05	2.08E-06	1.99E-05	6.26E-06	3.23E-05	4.48E-06	8.16E-06	2.91E-06	4.42E-06	1.14E-05
S_{skel}(CBE←CBV)	3.34E-05	1.44E-06	2.72E-05	6.31E-06	4.67E-05	3.39E-06	8.11E-06	2.34E-06	3.93E-06	1.35E-05
S_{skel}(CBV←CBV)	2.42E-05	2.78E-06	2.04E-05	6.99E-06	3.26E-05	5.59E-06	9.65E-06	3.75E-06	5.29E-06	1.22E-05

Table 5.11: Comparison of skeletal averaged S values (mGy MBq^{-1} s^{-1}) between the MIRD-11 (*5*), MIRDOSE2, MIRDOSE3 (*73*), and the present skeletal dosimetry model for different source-target combinations. In this table, the bone endosteum (BE) and the bone volume (BV) correspond to both cortical and trabecular regions. Note that for the new model, the cross-irradiation between the cortical and trabecular bones is assumed to be null.

Target* ← Source	**^{32}P**				**^{90}Y**			
	MIRD-11	**MIRDOSE2**	**MIRDOSE3**	**New Model**	**MIRD-11**	**MIRDOSE2**	**MIRDOSE3**	**New Model**
S_{skel}(TAM←TAM)	4.88E-05	9.91E-05	4.41E-05	6.74E-05	6.46E-05	1.34E-04	5.87E-05	8.99E-05
S_{skel}(TAM←TBE)	-	-	2.83E-05	2.52E-05	-	-	3.84E-05	3.45E-05
S_{skel}(TAM←TBV)	3.23E-05	4.96E-05	2.64E-05	2.33E-05	4.28E-05	6.67E-05	3.65E-05	3.25E-05
S_{skel}(TAM←CBV)	1.43E-06	0.00E+00	0.00E+00	0.00E+00	2.48E-06	0.00E+00†	0.00E+00†	0.00E+00
S_{skel}(BE←TAM)	-	1.85E-05	2.76E-05	3.21E-05‡	-	2.49E-05	3.71E-05	4.39E-05‡
S_{skel}(BE←TBE)	-	-	3.26E-05	3.87E-05‡	-	-	4.17E-05	5.00E-05‡
S_{skel}(BE←CBE)	-	-	1.00E-06	2.31E-05‡	-	-	9.69E-07	2.84E-05‡
S_{skel}(BE←TBV)	-	2.31E-05	2.75E-05	3.55E-05‡		3.12E-05	3.66E-05	4.71E-05‡
S_{skel}(BE←CBV)	-	1.39E-05	4.89E-06	1.41E-05‡	-	1.87E-05	4.74E-06	1.97E-05‡
S_{skel}(BV←TAM)	6.53E-06	-	-	5.72E-06‡	8.26E-06	-	-	7.93E-06‡
S_{skel}(BV←CBV)	2.25E-05	-	-	2.00E-05‡	3.00E-05	-	-	2.70E-05‡
S_{skel}(BV←TBV)	1.28E-05	-	-	7.26E-06‡	1.73E-05	-	-	9.29E-06‡

* In MIRD 11, MIRDOSE2, and MIRDOSE3 models, final target regions designation did not separately consider trabecular and cortical region of both bone volume and endosteum regions.

† Only electron component

‡ Assume no cross irradiation between the trabecular and cortical bones

CHAPTER 6

APPLICATION TO THE SELECTION OF RADIONUCLIDES FOR PALLIATION OF BONE PAIN FROM METASTATIC OSSEUS LESIONS

Introduction

The use of bone-seeking radionuclides to relieve pain caused by osseus metastatic lesions has been a topic of considerable interest for over 50 years. Phosphorus-32 (32P orthophosphate) and strontium-89 (89Sr strontium chloride) were the first radiochemicals to be evaluated for this purpose, with the first clinical use dating back to 1941 (see Silberstein (*101*) and Ackery and Yardley (*102*) for reviews on 32P and 89Sr, respectively). These radionuclides are energetic beta emitters with mean energies (physical half-lives) of 695 keV (14.26 d) and 583 keV (50.5 d), respectively (Table 6.1). The relatively long-range of these energetic beta particles in soft tissue and bone (Table 6.1) can result in significant irradiation of the marrow compartment, which can lead to depression of bone marrow function. As a consequence, a great deal of research has been devoted to find new radiochemical forms of 32P as well as new radionuclides with more favorable radiation properties. Among the 32P radiochemicals that have been studied are phosphonates and diphosphonate (disodium etidronate), however, these also resulted in high marrow toxicity (*103*).

The general lack of enthusiasm for ^{32}P and ^{89}Sr as palliative agents has led to the search for other suitable radiochemicals. Among them are ^{186}Re hydroxyethylene diphosphonate (HEDP) and ^{153}Sm ethylene diamine tetramethylene phosphonate (EDTMP) (*104, 105*). These radionuclides have physical half-lives of only 3.8 d and 1.9 d, and mean beta particle energies of about 350 keV and 225 keV, respectively. The significant pain reduction in the absence of high marrow toxicity observed for ^{153}Sm EDTMP recently led to its FDA approval for palliation of bone pain

While the clinical efficacy of ^{153}Sm EDTMP appears to be good (*106*), there may be room for continued improvement in reducing bone pain while minimizing adverse effects to the marrow. The recent studies with the low-energy electron emitter ^{117m}Sn were carried out with this goal in mind (*107-109*). In the present work, a theoretical framework is developed to aid in the selection of radionuclides with optimal radiation characteristics which are likely to maximize the dose delivered to the bone while minimizing the absorbed dose delivered to the red bone marrow. These calculations allow a physical comparison of the relative efficacy of various radionuclides to meet the overall objective of this modality.

Methods

Dosimetric Relative Advantage Factor

All radionuclides that have been explored for bone pain relief are bone-seekers, hence, the bone marrow is the critical organ for this modality. Therefore, the principal goal for alleviating bone pain with radiopharmaceuticals is to deliver a sufficiently high radiation dose to the bone while delivering the lowest possible dose to the red marrow. The radiation properties of the radionuclide play a major role in achieving this goal. Consequently, it is of interest to compare the capacity of various radionuclides which are likely to meet the stated goal based on their radiation properties. One can quantify the advantage of a given radionuclide compared to a reference radionuclide using a quantity called the dosimetric relative advantage factor (RAF).

According to the MIRD formalism (*71*), the mean absorbed dose to a given target region r_k from radioactivity localized in source regions r_h is given by

$$\overline{D}(r_k) = \sum_h \tilde{A}(r_h)\ S(r_k \leftarrow r_h), \qquad \text{Eq. 6.1}$$

where $\tilde{A}(r_h)$ is the cumulated activity in source region r_h, and $S(r_k \leftarrow r_h)$ is the mean absorbed dose to target region r_k per unit cumulated activity in r_h. Hence, the mean absorbed dose to a bone compartment (i.e. bone volume or endosteum) from a radionuclide distributed in both the bone and bone marrow can be written as

$$\overline{D}(\text{bone}) = \tilde{A}(\text{bone})\ S(\text{bone} \leftarrow \text{bone}) + \tilde{A}(\text{marrow})\ S(\text{bone} \leftarrow \text{marrow}). \qquad \text{Eq. 6.2}$$

Similarly, the mean absorbed dose to the bone marrow from radioactivity distributed in these same bone compartment and bone marrow is given by

$$\overline{D}(\text{marrow}) = \tilde{A}(\text{bone})\ S(\text{marrow} \leftarrow \text{bone}) + \tilde{A}(\text{marrow})\ S(\text{marrow} \leftarrow \text{marrow}). \qquad \text{Eq. 6.3}$$

In the palliation of bone pain, one desires to maximize the absorbed dose to the bone compartment while minimizing the absorbed dose to the bone marrow; consequently, the ratio of the absorbed dose to the bone compartment compared to the dose to the bone marrow is of interest.

$$\frac{\overline{D}(\text{bone})}{\overline{D}(\text{marrow})} = \frac{\tilde{A}(\text{bone})\ S(\text{bone} \leftarrow \text{bone}) + \tilde{A}(\text{marrow})\ S(\text{bone} \leftarrow \text{marrow})}{\tilde{A}(\text{bone})\ S(\text{marrow} \leftarrow \text{bone}) + \tilde{A}(\text{marrow})\ S(\text{marrow} \leftarrow \text{marrow})} \qquad \text{Eq. 6.4}$$

Generally, for bone-seeking radionuclides, the cross-dose to the marrow and bone from all other sources of activity in the body (e.g. muscle, kidney) is small compared to the contributions from activity in the marrow and bone and may therefore be ignored in these estimates. Hence, the advantage of test radionuclide T compared to reference radionuclide R for palliation of bone pain may be expressed as a dosimetric relative advantage factor (RAF) according to Equation 6.5

$$\mathrm{RAF} = \left.\frac{\overline{\mathrm{D}}_{\mathrm{T}}(\text{bone})}{\overline{\mathrm{D}}_{\mathrm{T}}(\text{marrow})}\middle/\frac{\overline{\mathrm{D}}_{\mathrm{R}}(\text{bone})}{\overline{\mathrm{D}}_{\mathrm{R}}(\text{marrow})}\right. = \frac{\overline{\mathrm{D}}_{\mathrm{T}}(\text{bone})}{\overline{\mathrm{D}}_{\mathrm{T}}(\text{marrow})}\times\frac{\overline{\mathrm{D}}_{\mathrm{R}}(\text{marrow})}{\overline{\mathrm{D}}_{\mathrm{R}}(\text{bone})}, \text{ and} \qquad \text{Eq. 6.5}$$

$$\mathrm{RAF} = \frac{\tilde{\mathrm{A}}_{\mathrm{T}}(\mathrm{B})\ \mathrm{S}_{\mathrm{T}}(\mathrm{B}\leftarrow\mathrm{B})+\tilde{\mathrm{A}}_{\mathrm{T}}(\mathrm{M})\ \mathrm{S}_{\mathrm{T}}(\mathrm{B}\leftarrow\mathrm{M})}{\tilde{\mathrm{A}}_{\mathrm{T}}(\mathrm{B})\ \mathrm{S}_{\mathrm{T}}(\mathrm{M}\leftarrow\mathrm{B})+\tilde{\mathrm{A}}_{\mathrm{T}}(\mathrm{M})\ \mathrm{S}_{\mathrm{T}}(\mathrm{M}\leftarrow\mathrm{M})}\times\frac{\tilde{\mathrm{A}}_{\mathrm{R}}(\mathrm{B})\ \mathrm{S}_{\mathrm{R}}(\mathrm{M}\leftarrow\mathrm{B})+\tilde{\mathrm{A}}_{\mathrm{R}}(\mathrm{M})\ \mathrm{S}_{\mathrm{R}}(\mathrm{M}\leftarrow\mathrm{M})}{\tilde{\mathrm{A}}_{\mathrm{R}}(\mathrm{B})\ \mathrm{S}_{\mathrm{R}}(\mathrm{B}\leftarrow\mathrm{B})+\tilde{\mathrm{A}}_{\mathrm{R}}(\mathrm{M})\ \mathrm{S}_{\mathrm{R}}(\mathrm{B}\leftarrow\mathrm{M})}$$

where the letters B and M denote bone and marrow, respectively. If the cumulated activity in the bone $\tilde{A}(B) >> \tilde{A}(M)$ as expected for bone pain agents, and $S(M \leftarrow B)$ and $S(M \leftarrow M)$ are of the same order of magnitude (see Table 6.2), then Equation 6.5 may be approximated by

$$\mathrm{RAF} \approx \frac{\mathrm{S}_{\mathrm{T}}(\text{bone}\leftarrow\text{bone})}{\mathrm{S}_{\mathrm{T}}(\text{marrow}\leftarrow\text{bone})}\times\frac{\mathrm{S}_{\mathrm{R}}(\text{marrow}\leftarrow\text{bone})}{\mathrm{S}_{\mathrm{R}}(\text{bone}\leftarrow\text{bone})}. \qquad \text{Eq. 6.6}$$

Average Skeletal S Values for Human Trabecular Bone

The S values for sources and targets in trabecular bone of the human skeleton are taken from Chapter 5, and summarized in Table 6.2. The S values represent a weighted skeletal average over twenty-two trabecular bone regions (thirteen containing active marrow) of a 70-kg standard man including cranium, mandible, humerus (upper and lower half), radius, ulna, hands, scapulae, clavicles, sternum, ribs, cervical vertebrae, thoracic vertebrae, lumbar vertebrae, sacrum, os coxae, femur (upper and lower half).

Details of the Monte Carlo dosimetry model for trabecular bone are given in Chapter 3, whereas, details of the S value determinations are described in Chapter 5. The skeletal average S values for human trabecular bone, summarized in Table 6.2, are used below to ascertain the relative dosimetric merits of various radionuclides for palliation of bone pain.

Results

The average skeletal S values for human trabecular bone given in Table 6.2 are used in Equation 6.6 to calculate relative advantage factors for the radionuclides ^{32}P, ^{89}Sr, ^{186}Re, ^{153}Sm, ^{177}Lu, ^{169}Er, ^{117m}Sn, and ^{33}P. All of these radionuclides are associated with radiopharmaceuticals that localize within the skeleton. Relative advantage factors are calculated for two different source regions, namely the endosteum and bone volume of trabecular bone. These source regions correspond to those observed for various radiopharmaceuticals that utilize the radionuclides listed in Table 6.1. The bone volume is taken as the relevant target region (*49*).

When the endosteum is taken as the source region, and bone volume is taken as the target region, one obtains the RAF values given in Table 6.3. These RAF values allow an intercomparison among all of the radionuclides. The RAF's range from 1 to 2 with the maximum value representing a comparison between the energetic beta emitter ^{32}P and the low-energy beta emitter ^{33}P. Similarly, when the bone volume is taken as both source and target one obtains the RAF values given in Table 6.4. In this case, RAF values as high as 6.8 are observed when ^{32}P and ^{33}P are compared. It should be noted that the model predicts that the efficacy of ^{32}P and ^{89}Sr are essentially the same regardless of how the radioactivity is distributed in the bone tissue. In addition, for the radionuclides examined in these calculations, the order of preference in terms of their capacity to irradiate bone while sparing marrow is ^{33}P, ^{117m}Sn, ^{169}Er, ^{177}Lu, ^{153}Sm, ^{186}Re, ^{89}Sr, and ^{32}P. As expected, the radionuclides are in order of ascending mean particle emission energy (Table 6.1).

Discussion

The results presented above suggest that radionuclides which emit short-range electrons/beta-particles offer a distinct advantage over energetic beta-particle emitters in the palliation of bone pain caused by osseus metastases. Relative advantage factors ranging as high as ~7 were obtained for the lowest energy emitter ^{33}P when compared to the energetic beta emitter ^{32}P. This advantage factor may be conservative given that the absorbed dose to the metastatic lesions themselves may be of more relevance than the mean absorbed dose to the bone volume as a whole (*75*). There are, however, several factors that have not been folded into these calculations which may affect the overall relative advantage of one radionuclide compared to another. Among the many potential factors not considered in the present model are physical half-life, microscopic distribution of the radionuclide, fraction of injected activity taken up by bone, kinetics of radioactivity in bone, etc. For example, the physical half-life affects the injected activity required, as well as the duration of pain relief. Longer-lived radionuclides generally appear to require lower injected activities and demonstrate more prolonged pain relief, however, they also are slower acting in terms of the initial reduction in pain (*49*). In addition, they may lengthen the time required between injections when bone marrow toxicity is an issue.

Such issues may also need to be taken into account when selecting the optimal radionuclide for palliation of bone pain.

It is also of interest to note that radionuclides such as ^{117m}Sn and ^{33}P can offer a significant advantage over ^{153}Sm, the radionuclide that was recently approved by the FDA for alleviation of bone pain. While the advantage is small when endosteum is taken as the source and bone volume is taken as the target (Table 6.3), it is substantial when the bone volume is taken as both source and target. Given that ^{117m}Sn-DTPA and ^{153}Sm EDTMP are known to localize almost exclusively on bone surfaces, whereas a substantial fraction of ^{33}P orthophosphate localizes in the bone volume (*110, 111*), perhaps the most useful comparison between these three radionuclides would take differences in biodistribution into account. Using the skeletal S values in Table 6.2 and the definition of the RAF given by Equation 6.6, the RAF of ^{33}P orthophosphate over ^{153}Sm EDTMP can be calculated to be 6.2 when ^{33}P and ^{153}Sm are distributed in the bone volume and endosteum, respectively. This is compared to a RAF of only 1.4 between the surface seekers ^{117m}Sn-DTPA and ^{153}Sm EDTMP (Table 6.3). A RAF of 4.5 is obtained when ^{33}P orthophosphate is similarly compared to ^{117m}Sn-DTPA. Therefore, based on dosimetric considerations only, ^{33}P orthophosphate appears to be an excellent choice for palliation of bone pain due to osseus metastases. This radionuclide was previously suggested as a potential candidate by Potsaid et al. (*103*) when they found that ^{32}P caused marrow toxicity regardless of its radiochemical form. Our experiments in laboratory mice using intravenously administered ^{32}P and ^{33}P indeed show that for a given absorbed dose to the bone, the survival of granulocyte/macrophage colony forming cells (GM-CFC) in the femoral marrow is considerably higher with ^{33}P than ^{32}P (*112*). Given that GM-CFC survival is a good indicator of marrow toxicity, this suggests that ^{33}P offers a distinct therapeutic advantage. There are some drawbacks to this radionuclide, among them is the absence of imaging photons, and the high injected activities that may be required due to the low energy of the emitted beta particles. These drawbacks, however, are more than offset by the high dosimetric relative advantage factors predicted for this radionuclide.

Table 6.1: Radionuclide Properties for Bone Pain Palliation Therapy

Radionuclide	Half-Life (days)[‡]	Mean Beta Energy (keV)	Mean Range in Bone[†] (mm)	Yield/Decay
P-32	14.26	695	1.7	1.0
P-33	25.34	76.6	0.05	1.0
Sr-89	50.53	583	1.4	1.0
Sn-117m	13.6	135[*]	0.15	1.14
Sm-153	1.95	225	0.32	1.0
Er-169	9.4	100	0.09	1.0
Lu-177	6.71	133	0.15	1.0
Re-186	3.78	323	0.64	0.94

[*] Conversion electron

[†] Approximate range taken from ICRU Report 37 (*83*).

[‡] Physical half-lives and mean energies taken from Refs. (*99, 100*).

Table 6.2: Skeletal Average S Values[*] for Human Trabecular Bone (mGy MBq^{-1} s^{-1})

Source Region	Target Region	P-32	P-33	Sr-89	Sn-117m	Sm-153	Er-169	Lu-177	Re-186
TAM	**TAM**	6.74E-05	9.63E-06	5.71E-05	1.89E-05	3.01E-05	1.25E-05	1.71E-05	3.57E-05
TAM	**TBE**	5.55E-05	3.65E-06	4.61E-05	7.91E-06	1.69E-05	5.37E-06	8.58E-06	2.54E-05
TAM	**TBV**	3.30E-05	1.26E-06	2.71E-05	3.07E-06	8.52E-06	2.24E-06	3.96E-06	1.42E-05
TBE	**TAM**	2.52E-05	1.88E-06	2.10E-05	4.01E-06	8.10E-06	2.70E-06	4.21E-06	1.17E-05
TBE	**TBE**	6.69E-05	2.33E-05	5.84E-05	3.47E-05	5.83E-05	2.97E-05	3.10E-05	4.36E-05
TBE	**TBV**	3.56E-05	5.32E-06	3.04E-05	1.09E-05	1.60E-05	6.78E-06	9.57E-06	1.94E-05
TBV	**TAM**	2.33E-05	8.32E-07	1.92E-05	2.03E-06	5.90E-06	1.50E-06	2.70E-06	9.94E-06
TBV	**TBE**	6.13E-05	6.97E-06	5.19E-05	1.50E-05	2.42E-05	9.45E-06	1.39E-05	3.17E-05
TBV	**TBV**	4.19E-05	1.02E-05	3.66E-05	1.92E-05	2.63E-05	1.25E-05	1.59E-05	2.62E-05

[*] Mean absorbed dose to active marrow in trabecular bone per unit cumulated activity in source region.

Table 6.3: Dosimetric Relative Advantage Factors for Endosteum Source and Bone Volume Target

	^{32}P	**^{89}Sr**	**^{86}Re**	**^{153}Sm**	**^{177}Lu**	**^{169}Er**	**^{117m}Sn**	**^{33}P**
^{32}P	1.0							
^{89}Sr	1.0	1.0						
^{86}Re	1.2	1.1	1.0					
^{153}Sm	1.4	1.4	1.2	1.0				
^{177}Lu	1.6	1.6	1.4	1.2	1.0			
^{169}Er	1.8	1.7	1.5	1.3	1.1	1.0		
^{117m}Sn	1.9	1.9	1.6	1.4	1.2	1.1	1.0	
^{33}P	2.0	2.0	1.7	1.4	1.2	1.1	1.0	1.0

Table 6.4: Dosimetric Relative Advantage Factors for Bone Volume Source and Bone Volume Target

	^{32}P	**^{89}Sr**	**^{86}Re**	**^{153}Sm**	**^{177}Lu**	**^{169}Er**	**^{117m}Sn**	**^{33}P**
^{32}P	1.0							
^{89}Sr	1.1	1.0						
^{86}Re	1.5	1.4	1.0					
^{153}Sm	2.5	2.3	1.7	1.0				
^{177}Lu	3.3	3.1	2.2	1.3	1.0			
^{169}Er	4.6	4.4	3.2	1.9	1.4	1.0		
^{117m}Sn	5.3	5.0	3.6	2.1	1.6	1.1	1.0	
^{33}P	6.8	6.4	4.7	2.8	2.1	1.5	1.3	1.0

CHAPTER 7
THE DOSIMETRY OF NONUNIFORM ACTIVITY DISTRIBUTIONS

Introduction

Traditionally, the MIRD schema (*71*) has been applied to nonuniform activity distributions only to the extent that radioactivity localizes in different source organs. Within each organ, or major component of an organ, the source has been assumed to be uniformly distributed (*5, 20*). However, there is nothing intrinsic in the MIRD schema that precludes its extension to smaller regions (*7*). The purpose of this chapter is to introduce dosimetry tools for nonuniform source distributions using small suborgan voxel dimensions and to review current methods of dose calculation using patient-specific imaging data.

Current calculational methods for the dosimetry of nonuniform activity distributions generally use either dose point-kernel convolution techniques or direct Monte Carlo radiation transport. A third concept is defined in this chapter with applications to voxel dosimetry: the voxel S value approach based upon the MIRD schema. In this chapter, this simple approach to the dosimetry of nonuniform activity distributions is thoroughly investigated and developed. Examples are also provided wherein voxel S values are applied to nonuniform activity distributions to assess isodose contours and dose volume histograms within treated tissue regions. Extensions of the approach are applied to autoradiographic data on radiopharmaceutical localization.

Spatial Levels of Source/Target Region Definition

Internal dosimetry calculations can be performed over a broad range of target dimensions: whole organs, suborgan regions, small-scale tissue regions, multicellular clusters, single cells, and even subcellular regions. In each case, the MIRD schema may be applied to estimate the average absorbed dose for any user-defined source-target geometry. At each spatial level, three steps are required: (i) the source and target regions of a representative dosimetric model must be defined, (ii) the activity as a function of time in the source regions must be quantified or assumed, and (iii) calculations of absorbed fractions of energy and radionuclide S values must be made for all radiations of interest and for all source-target region combinations.

Organ Dosimetry

The minimum scale for source region definition in a dosimetric model is typically guided by the spatial level at which the investigator can accurately quantify the activity of the radiopharmaceutical. Through the late 1970s, activity quantification was primarily performed via planar imaging in which regions-of-interest were delineated for whole organs. Consequently, the MIRD schema was generally applied at that same whole-organ level with both source and target regions defined as individual model organs. As described in MIRD Pamphlet No. 5-Revised (MIRD 5R) (*20*), Monte Carlo photon transport was performed within a mathematical anthropomorphic model resembling Reference Man (*39*) so as to assess values of specific absorbed fractions at the whole organ level. Within each source organ, the activity was assumed to be uniformly distributed. This assumption was embodied in the method by which photon transport was simulated within the MIRD 5R mathematical model. Radionuclide S values were then developed for individual organs as published in MIRD Pamphlet No. 11 (*5*). At that time, nuclear medicine practice was primarily diagnostic in nature, and the average absorbed dose to whole organs was considered sufficient for risk estimation purposes. To this day, imaging for radiation dosimetry is usually performed at the whole organ level (*113*).

Suborgan Dosimetry

Suborgan dosimetry followed the introduction of commercially developed positron emission tomography (PET) imaging in the mid-to-late 1970s and single-photon emission computed tomography (SPECT) in the early 1980s. In neuroimaging studies, for example, SPECT images have been used to quantify radiopharmaceutical activity within brain substructures such as the cerebral cortex or caudate nuclei (*14-16*). These agents may be considered to distribute nonuniformly within the brain. Correspondingly, the MIRD schema may be used to assess subregional brain doses if a dosimetric model is constructed that specifically includes these structures as source and target regions (see Reference *3*). While the activity within the whole brain is no longer considered to be uniformly distributed, one still makes the assumption in applying the MIRD schema that the activity is uniformly distributed within the subregion (cerebral cortex or caudate nuclei) and that the tissues within that subregion are homogeneous in composition. Other examples of suborgan dosimetry include the development of a multi-chamber heart model (*114, 115*) and multiregion models of the kidney (*116-118*).

Voxel Dosimetry

"Voxel dosimetry" is defined as the calculation of radiation absorbed dose to tissue regions with dimensions ranging from a few centimeters to hundreds of micrometers. As the name implies, voxel dosimetry is generally associated with tomographic imaging or autoradiographic techniques for activity quantification. This level of dosimetry is of interest in (i) radioimmunotherapy (RIT) with radiolabeled monoclonal antibodies, (ii) radioiodine therapy of thyroid carcinoma, and (iii) intratumoral injection of therapy radiopharmaceticals. In these applications, source regions may be defined as individual tumors or even regions within a tumor. Both the tumor and normal tissues acquire nonuniform distributions of activity from variations in the pharmacokinetics (delivery, uptake, site-specific binding, and clearance) of the radiopharmaceutical. These nonuniform activity distributions lead to nonuniformities in the absorbed dose profile within these entities. "Cold spots" that develop from dose nonuniformity may allow the regrowth of the tumor from surviving cancer cells; consequently, the mean absorbed dose to tumor may not be the most useful parameter for evaluating clinical results (*119-121*). Calculation of isodose contours or dose volume histograms within these tissue regions is therefore desirable. The corresponding dose nonuniformity will depend on the emission spectrum of the radionuclide of interest. These dose profiles will be most nonuniform for short-range radiations (alpha particles and low-energy beta particles). X-rays and gamma-rays will tend to distribute the dose more evenly in regions local to the activity deposition.

With the development of PET and SPECT, in vivo quantification of activity distributions can be performed with resolutions adequate for voxel dosimetry at the 3-6 mm level. Attenuation corrections, scattered photon corrections, partial volume effects, and reconstruction algorithms can vary from system to system and application to application with a resulting variation in system spatial resolution. The voxel size will vary depending upon the image matrix size and the camera field of view. Typically, these modalities allow quantitative activity data to be acquired in a 64 x 64 or 128 x 128 image matrix yielding cubic voxels of ~6 mm or ~3 mm on edge, respectively, for a 40-cm field-of-view.

Multicellular, Cellular, and Subcellular Dosimetry

Multicellular, cellular, and subcellular dosimetry requires activity quantification at smaller dimensions (tens to hundreds of micrometers). At present, acquiring the source distribution data necessary to perform dosimetry at these dimensions directly from in vivo imaging is not feasible. However, measurements can be made using tissue specimens acquired through biopsy or autopsy. Autoradiographic techniques using films or phosphor plates may then be applied to quantify activity within groups of cells (multicellular) and to some extent within single cells (using high-resolution film techniques) (*122*). Several investigators have focused their efforts on dosimetry models for single cells or cell clusters (*4, 78, 123-133*). Source regions in these models include the cell surface, cytoplasm, and nucleus. These models are then used to calculate absorbed fractions and cellular S values for use within the MIRD schema (*4*). New ion beam spectrometry techniques to map tracer distributions at the micrometer level have allowed the calculation of dose profiles at the nuclear level (*134*). At the subnuclear level, however, the concept of absorbed dose alone, whether applied as the average or as part of a distribution (as in microdosimetry), may not be adequate as a predictor of biological response (*7, 8*). When the target is deemed to be the DNA molecule, mechanistic models of radiation transport and radiation chemistry are frequently employed whereby direct damage by secondary particles and indirect damage by free radical radiolytic products are explicitly considered (*135-138*).

Applications to Patient-Specific Dose Estimates

Patient-specific dose estimates are important when (i) there is a wide variation in patient-to-patient pharmacokinetics of the injected radiopharmaceutical, (ii) organ absorbed doses are large, or (iii) normal organ toxicity is possible. Diagnostic or treatment-planning dosimetry can provide information that guides the choice of radiopharmaceutical and administered activity required to achieve an adequate dose to tumor without serious normal tissue toxicity. Radiobiologic information of importance concerning the relative efficacy and toxicity of internal emitters compared to external beam therapy requires information on dose distributions and toxicity on a patient-by-patient basis. Patient-specific suborgan dosimetry has become feasible with the development of high-resolution, 3D anatomic (MRI, CT) and accurate 3D physiologic (PET, SPECT) imaging devices, stereotactic biopsy, and methods of dose calculation (Monte Carlo radiation transport, point-kernel convolution, and the MIRD schema).

Given voxel-based estimates of the activity distribution and organ-based anatomy, the MIRD schema can be used to calculate absorbed dose to the different voxels. Voxel dosimetry calculations assume a homogeneous tissue composition and a uniform radionuclide distribution within individual voxels. Dose volume histograms within the tumor and normal organs can be generated by displaying the distribution of target voxel doses. As with all target regions defined under the MIRD schema, the dose to the target voxel will nevertheless be its average dose.

Current Methods for Determining Voxel Cumulated Activity

Quantitative SPECT and PET provide means by which the spatial distribution of activity with time may be determined in vivo within a source organ or suborgan region. MIRD Pamphlet No. 16 (*113*) presents general details concerning quantitative SPECT and PET imaging. Ideally, voxel dosimetry would use activity per image voxel as a function of time. One could then integrate the activity-time curve for each image voxel thus obtaining a voxel-specific cumulated activity. Coregistration of serial SPECT or PET source organ acquisitions for the purpose of determining individual voxel cumulated activities is technically demanding. However, activity in subregions (i.e., groups of voxels) within a source organ can be obtained (i) from sequential SPECT or PET imaging or (ii) from SPECT or PET imaging performed at a single time point in conjunction with sequential planar imaging. In this approach, voxel variations in the biokinetic behavior of the radiopharmaceutical are ignored. Additional information on quantitative SPECT and PET imaging may be found in References *139-145*.

In situations where tissue biopsy or autopsy are possible, detailed information on activity distributions may be obtained through the use of autoradiography, implantation of thermoluminescent dosimeters, or combinations of both. For a review of these techniques, the reader is referred to Reference *122*.

Current Methods of Dose Calculation

Three broad computational approaches are available for handling nonuniform dosimetry at the voxel level: dose point-kernel convolution, direct Monte Carlo radiation transport, and voxel S values. At present, the dose point-kernel approach has been the most widely utilized technique primarily due to the demanding computational requirements of direct Monte Carlo and the unavailability of tabulated S values at the voxel level. Several articles have been published outlining the use of dose point-kernels for nonuniform dose assessment within radionuclide treatment planning systems (*139, 140, 145, 146*). Within the past few years, however, the increased computational power of modern desktop computers and the widespread availability of transport codes will most likely increase the use of direct Monte Carlo transport for voxel dosimetry (*147*). The third approach, the use of voxel S values with the MIRD schema, has recently been suggested (*148, 149*) and is equivalent in concept to the voxel source kernel (VSK) approach (*150, 151*).

In this section, data sources for both photon and electron dose point-kernels are reviewed and include a discussion of the use and potential limitations of the dose point-kernel approach to voxel dosimetry. Techniques for performing direct Monte Carlo radiation transport are then presented. The voxel S value approach is given in the following section.

Dose Point-kernels for Electrons

A dose point-kernel represents the radial distribution of absorbed dose around an isotropic point source of radiation in an infinite homogeneous medium (typically water). Dose point-kernels were first calculated for monoenergetic electrons by Spencer using a numerical solution of the transport equation (*152, 153*). These results were subsequently averaged over a number of beta-particle energy spectra by a number of investigators (*154-156*). Calculations such as these can serve as standards against which more approximate empirical expressions for dose distributions may be compared (*157-163*). Many investigators have opted to use these empirical expressions because they give the dose point-kernel as an analytic function rather than as tabular data, thus facilitating dose computation.

The dose point-kernel results of Spencer are based upon the continuous slowing-down approximation (CSDA); as such they neglect statistical fluctuations in energy loss that can underestimate electron doses at large distances. At shorter distances, Spencer's results agree with experimentally measured beta-particle dose distributions (*164, 165*). A major advance in beta particle dosimetry followed the development of the ETRAN Monte Carlo code which thus avoided the need to use the CSDA (*166, 167*). ETRAN was used to recalculate dose kernels for monoenergetic electrons (*168*) and these dose kernel results were subsequently averaged over the beta spectra for six radionuclides of interest in radioimmunotherapy (*161*). As expected, the average doses at distances far from the source were larger than those predicted on the basis of Spencer's calculations. In addition, they were closer to experimental observations.

Several improvements have been made to the ETRAN code since 1973. In particular, revisions were made to both the electron stopping powers (*169*) and bremsstrahlung cross sections (*170*), and an error in sampling of the Landau/Blunck-Liesegang distribution of energy losses was corrected (*166, 171, 172*). In 1991, dose point-kernels for monoenergetic electrons were recalculated using these improvements (*173*). Other electron transport codes have also been used to generate dose point-kernels. In 1990, dose point-kernels were published for monoenergetic electrons and for eight radionuclides of interest in radioimmunotherapy based upon Monte Carlo transport calculations using the EGS4 code system (*174*). In 1992, tabular data were published for dose point-kernels for monoenergetic electrons from 25 keV to 4 MeV and for 32 beta-particle emitters (*175*). These calculations were based upon the ACCEPT code, a derivative of the ETRAN code which incorporates the improvements mentioned above. Dose point-kernels from the ACCEPT code were additionally published in report form for some 147 beta emitters (*176*).

Dose Point-kernels for Photons

For radionuclides that also emit photons, the photon contribution to the dose should be included in voxel dosimetry evaluations. For these calculations, the methods originally presented in MIRD Pamphlet No. 2 (MIRD 2) are frequently employed (*177*). For a point isotropic photon source in a uniform, infinite water medium, one may define Φ(x), the point isotropic specific absorbed fraction, as the fraction of emitted photon energy absorbed per unit mass at radial distance x from the source:

$$\Phi(x)=\left[\frac{\mu_{en}}{\rho}\cdot\frac{1}{4\pi x^2}\cdot e^{-\mu x}\right]B_{en}(\mu x), \qquad \text{Eq. 7.1}$$

where μ is the linear photon attenuation coefficient at the source energy, μ_{en} the linear photon energy-absorption coefficient at the source energy, ρ is the mass density of the medium, and B_{en} is the energy-absorption buildup factor which takes into account the contribution of scattered photons to the energy deposited at μx mean-free-paths (mfps) from the source point. The buildup factors published in MIRD 2 were obtained by solving the photon transport equation using the moments method of Spencer and Fano (*178*). The buildup factors were tabulated for 35 values of μx ranging from 0.05 to 20.0 and for 19 photon energies ranging from 15 keV to 3 MeV. In addition, the values were fit to a 10th-order polynomial for use in interpolating between values of energy and μx. Additional empirical equations utilizing the tabular data of MIRD 2 have also been published (*179, 180*).

More recently, the EGS4 code was employed to generate photon dose point-kernels in water for 14 radionuclides of interest in nuclear medicine (*181*). In these calculations, the emission spectrum of each radionuclide was used directly in the transport simulations. The computed values of photon dose point-kernels were subsequently fit to a six-parameter expression for subsequent use in a radionuclide treatment planning system.

Methods of Applying Dose Point-Kernels

For either monoenergetic particles or for an emission spectrum for a specific radionuclide, the dose point-kernel represents the mean absorbed dose at a given radial distance per transition from an isotropic point source located within a homogeneous, infinite medium. If one considers the activity within the source region as a three-dimensional grid of point sources, the absorbed dose at a target point is a superposition of contributions from all point sources surrounding this target point (*146*). This superposition is a time-consuming mathematical process called convolution. Fast Fourier or Fast Hartley transforms may be employed to increase the computational speed of the convolution (*145, 150, 182*). The requirement for a medium of homogeneous composition can be problematic, however, when patient-specific activity is acquired within regions of the body with known tissue inhomogenieties. Examples include both air/tissue interfaces in the lungs or near body surfaces, and bone/tissue interfaces near skeletal regions. In these cases, the use of point-kernels derived for homogeneous media may lead to substantial errors in the reported dose distributions (*183*).

Quantitative SPECT or PET imaging generally yields activity within voxels with a defined volume and shape (cubical or parallelepiped). Consequently, the use of dose point-kernels necessitates decisions as to how the activity is to be distributed within a source voxel and where the dose is to be reported with respect to these source voxels. For the source voxels, one may choose to either collapse the activity to the voxel centroid or uniformly distribute the activity throughout the source voxel volume. Target regions may be defined as the voxels within the image data set (which may or may not correspond to source voxels containing activity), the voxel centroids, or an independent set of target points disconnected from the source voxel array. If one chooses to distribute the activity within the source voxels and to average the dose across the volume of the target voxels, one must perform a volume integration over both the source and target voxels. This six-dimensional integration can be reduced to a one-dimensional integration through the use of geometry factors or point-pair distance distributions which are specific to the source and target geometries (*121, 184, 185*). Unfortunately, analytical expressions for geometry factors for cubical source-target geometries are not readily available. Examples of the use of dose point-kernels in the assessment of 3D dose distributions and their use in RIT treatment planning may be found in References *139, 140, 145,* and *186-188*. A summary of methods specific to beta particle dosimetry are reviewed in References *189* and *190*.

The popularity of the dose point-kernel approach to voxel dosimetry lies in its speed of computation relative to Monte Carlo radiation transport, particularly when employed in analytic form and when applied to point source and point targets. As noted above, however, the point-kernel approach can lead to errors within regions of the body associated with tissue/air or tissue/bone interfaces. Furthermore, the method does not account for variations in atomic number throughout a tissue region that may influence the distribution of dose delivered by low-energy photons. In situations where tissue inhomogenities must be considered, direct Monte Carlo transport methods may be used.

Applications of Direct Monte Carlo Radiation Transport

While several Monte Carlo codes exist that allow the transport of photons and electrons in user-defined geometries, two codes are particularly useful for voxel dosimetry applications primarily due to their ready availability, continuing developmental support, broad user-group membership, and extensive benchmarking. These include Version 4 of the Electron-Gamma Shower transport code system (EGS4), and the Version 4B of the Monte Carlo N-Particle transport code system (MCNP). Both of these codes may be obtained from the Radiation Safety Information Computational Center at the Oak Ridge National Laboratory.[6]

The EGS4 code was originally developed at the Stanford Linear Accelerator Center for use in computation of electron-photon cascades in high-energy physics. Due to increased interest in using EGS4 within medical physics and internal dosimetry applications, the transport capabilities of the code have been extended to lower particle energies. The EGS4 code utilizes a path-segment model for electron transport whereas simulation of photon transport is achieved through conventional Monte-Carlo techniques, taking into account the generation and subsequent transport of all orders of the electron-photon cascade. These cascades include the generation of secondary and higher order electrons and the generation of bremsstrahlung photons. In the path-segment model, the numerous Coulomb collisions between electrons and atoms are not sampled individually. Instead, each electron track is divided into a moderate number of segments (less than 100) and the energy loss in each segment is sampled from a theoretical energy-loss straggling distribution that takes into account the combined result of many inelastic collisions. Each segment is further divided into two or more subsegments, and the net angular deflection in each subsegment is sampled from a theoretical multiple-scattering distribution that takes into account the combined effect of many elastic collisions. The small energy losses from inelastic collisions are treated in the CSDA (with the use of restricted stopping powers) and large energy losses are sampled individually.

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[6] Radiation Safety Information Computational Center, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6362

The EGS4 code system permits the treatment of multi-material media during both electron and photon transport. Consequently, explicit treatment of tissue heterogeneities can be implemented by assigning user-defined tissue compositions (soft tissue, bone, lung, or air) to various geometrical regions. Within the main program of EGS4, the user is required to develop specific geometrical routines for extracting information from the sampled particle histories.

The MCNP code was developed at Los Alamos National Laboratory for use in shielding and weapon design associated with the U.S. nuclear weapons program. MCNP allows the coupled transport of photons and neutrons in user-defined geometries of arbitrary media. It is a continuous-energy code that uses interpolation within available cross sectional data to obtain cross sectional information at all energies which are needed during the transport process. In Versions 4A and most recently in Version 4B, the Integrated TIGER Series (ITS) of electron transport codes (derivatives of the ETRAN code) have been included, thus allowing simulations of the electron-photon cascade. Both MCNP and EGS4 can be installed on Unix workstations and Personal Computer platforms. For further information about available electron transport codes, the reader is referred to Reference *191*.

Many of the details necessary to implement direct Monte Carlo radiation transport within a radioimmunotherapy treatment planning system have been reviewed (*147*). This review proposes coupling patient-specific imaging data with the EGS4 code to directly assess three-dimensional distributions of absorbed dose. In this method, quantitative SPECT or PET images would be used to assign values of cumulated activity to imaging voxels. Next, CT images would be coregistered with the SPECT or PET voxels whereby a voxel-specific CT number would be used to assign both an effective atomic number Z and mass density ρ to the tissue in each voxel. It is noted that treating each voxel as an independent geometry is inefficient, since boundary-crossing algorithms must be invoked, even during transport across arrays of voxels with equal values of ρ and Z. The solution proposed is to treat all contiguous voxels having similar Z as a single medium with variable densities, thus eliminating the need to resample interaction parameters at every voxel. The method was demonstrated using a voxel version of the adult MIRD anthropomorphic mathematical model (*20*) and by showing dose volume histograms generated for selected source and target organs (*147*). A similar system of direct Monte Carlo transport in a voxel geometry was recently reported elsewhere (*192*). Monte Carlo photon transport has also been applied to solid tumor dosimetry (*193-195*)

The Voxel S Value Approach

A third approach to voxel dosimetry allows one to apply the MIRD formalism to quantitative data on nonuniform distributions of activity within target organs, suborgan regions, and tumors. As noted above, SPECT and PET imaging allows in vivo determination of activity at the voxel level (*113*). Through the use of sequential scans during the washin, redistribution, and washout phases of the radiopharmaceutical within a source organ or region, cumulated activities per image voxel (or groups of voxels) may be determined. One approach, therefore, is to provide S values that correspond to the voxel geometry of the imaging data. As shown in Equation 7.2 below, the MIRD schema may be applied in a 3D array summation to assess the dose to a given target voxel k from

N surrounding source voxels h (including dose contributions from the target voxel itself, h=0):

$$\overline{D}(\text{voxel}_k) = \sum_{h=0}^{N} \widetilde{A}_{\text{voxel}_h}\, S(\text{voxel}_k \leftarrow \text{voxel}_h). \qquad \text{Eq. 7.2}$$

Evaluation of Equation 7.2 for all target voxels in the region of interest thus allows for calculations of isodose contours and dose-volume histograms within that same region.

A voxel S value is defined as the mean absorbed dose to a target voxel per radioactive decay in a source voxel, both of which are contained in an infinite homogeneous tissue medium. As a result, the voxel S value approach suffers from the same restrictions as the dose point-kernel convolution methods in that tissue inhomogeneities cannot be accommodated. Direct Monte Carlo radiation transport offers a generalized method for handling tissue inhomogeneities and for assessing their influence on the resulting dose distributions. Nevertheless, the voxel S value approach offers a convenient and rapid tool for voxel-scale dosimetry studies in a manner analogous to MIRD calculations at the level of whole organ dosimetry. More importantly, the use of voxel S values avoids the need to perform CPU-intensive volume integrations of the dose point-kernel over both the source and target volumes. In addition, voxel S values can be readily implemented without the need for time-consuming efforts required to calculate the dose from first principles (absorbed fractions, etc.).

In order to be able to use the voxel S value methodology for the dosimetry of nonuniform activity distribution, S values need to be available for the needed radionuclide, and for the voxel size at which the activity data were calculated. The following section of this chapter investigates the feasibility of the tabulation of S values for any radionuclides and any voxel sizes.

Tabulation of Voxel S values for cubical geometries

The Monte Carlo code EGS4 is used to perform all simulations of radiation transport and energy deposition. To ensure minimal dependence on the energy-loss step-size in the calculations, the PRESTA algorithms are utilized for all simulations (*10, 196*). For the transport, the geometry considered is a cubical array of target voxel regions with a centrally located source voxel. A total array of 41 x 41 x 41 voxel regions is considered with a surrounding buffer region to allow for particle backscatter. Twenty-one different voxel sizes are chosen (0.05 cm to 1 cm every 0.05 cm) in order to cover a full range of possible voxel dimensions.

Both electron and photon sources are considered, and monoenergetic absorbed fractions of energy in the voxel geometry are calculated using the EGS4 Monte Carlo code. Twelve energies are used between 10 keV and 4 MeV. The maximum percent energy loss per step due to continuous slowing down (ESTEPE) is chosen as 5%, and the electron and photon cut-off total energy (ECUT / AE and PCUT / PE) used are 512 keV and 0.01 keV, respectively. A total of 100,000 particles are sampled per particle energy during the transport simulations. The absorbed fraction of energy is scored in each target voxel (I, J, K) for each initial particle energy, and for each of the twenty-one different voxel sizes. Corresponding coefficient of variations are also derived and are found to be ~0.3% for $\phi < 10^{-1}$, ~2% for $10^{-2} < \phi < 10^{-1}$, ~5% for $10^{-3} < \phi < 10^{-2}$, ~15% for $10^{-4} < \phi < 10^{-3}$, ~40% for $10^{-5} < \phi < 10^{-4}$, ~80% for $10^{-6} < \phi < 10^{-5}$, and greater than 100% for $\phi < 10^{7}$.

The electron transport calculations include the production and subsequent transport of bremsstrahlung photons in the cubical arrays. In the photon transport calculations, explicit treatment of secondary electron transport is also included. The transport cross sections used are based upon the soft tissue composition of the Cristy and Eckerman anthropomorphic mathematical models (*18*) which has a density of 1.04 g cm^{-3}.

From the Monte Carlo simulations, absorbed fractions of energy are obtained as a function of the (I, J, K) position within the three-dimensional voxel matrix (the center cube (0,0,0) of the voxel matrix is taken as the source cube). Using the symmetry of the target voxels compared to the source voxel, only one eighth (one octant) of the full voxel array is used in the tabulations of absorbed fractions of energy, and the given absorbed fraction data are derived by averaging over each octant.

An even more efficient way of tabulating these voxels absorbed fractions of energy is as a function of the cube-to-cube voxel center-to-center distance (distance between the center of the source and target voxels). In tabulating absorbed fractions using a three-dimensional system of indexing, one obtains a repetition of some results of absorbed fraction. For example, the absorbed fraction at the target voxel (1, 0, 0) is the same that in the target position (0, 1, 0) and (0, 0, 1) due to their symmetric positions relative to the source. Some differences, however, may arise for target voxels that are at a similar distance from the source voxel, but have a different spatial orientation to each other. The four series of such voxels that are the closest to the source are given in Table 7.1. These possible differences in the absorbed fractions were investigated for several voxel sizes. The differences seen were always within one standard deviation of the calculated absorbed fractions for both electron and photon sources. It can therefore be concluded that the absorbed fractions of energy can be tabulated as a function of the source-to-target voxel center-to-center distance without the loss of absorbed fraction information. They are calculated using the (I, J, K) coordinates of the target voxel of interest and the voxel size a_0:

$$\mathrm{Dist}(I,J,K) = a_0\sqrt{I^2 + J^2 + K^2}\,. \qquad \text{Eq. 7.3}$$

Note that this distance is a function of the voxel size a_0. As an example, Table 7.2 gives the ten nearest voxel distances for four different voxel sizes. In this chapter, voxel dosimetric data will be tabulated in the three-dimensional voxel arrangement, or as a function of the source-to target voxel center-to-center distance, or as a function of the distance index. This distance index represents how close the target voxel is from the source voxel (a distance index of 2 represents the second closest voxels from the source voxel).

Absorbed fractions of energy are the dosimetric data calculated during the transport simulations. Since the absorbed dose to a target voxel is proportional to the specific absorbed fractions of energy (Φ) in this voxel (absorbed fraction in the target voxel per unit target mass), it may be more interesting to look at variations of Φ as a function of the distance to the source voxel. Figure 7.1 shows graphs of specific absorbed fractions of energy for monoenergetic photon sources for five voxel sizes (0.1, 0.3, 0.55, 0.75, and 1.0 cm), and for four energies (0.02, 0.1, 0.5, and 2.0 MeV). For a given energy and for each voxel size, Φ first decreases rapidly over the first few centimeters beyond the source voxel. This decrease is more pronounced for small voxel sizes (0.1 cm) than for larger voxels (1.0 cm). At distances from the source voxel larger than ~1 to 2 cm, Φ is seen to be independent of the voxel size.

On the four graphs of Figure 7.1, large fluctuations of the specific absorbed fraction are seen for particular voxel sizes and source-to-target distances. These fluctuations are a result of low statistics seen for low absorbed fractions of energy due to the small number of particles reaching the target voxels. These variations are also seen to be larger for the smaller voxel sizes, since they have smaller absorbed fractions (the absorbed fractions at several voxel distances from the source are inversely proportional to the volume of the target). At 2 MeV large fluctuations starting at ~1.5 cm for a voxel size of 0.1 cm, and at ~20 cm for a voxel size of 1 cm.

Figure 7.2 gives graphs of specific absorbed fractions of energy for monoenergetic electron sources for the same five voxel sizes and the same four particle energies as given in Figure 7.1. It can first be noticed that the stopping distances of the electrons are much shorter than the penetration distances of photons of similar energy. For distances less than ~2.0 cm, we observe large variations of Φ with voxel size due to the very short range of the electrons (see Table 7.3), and consequently we see very sharp decreases in dose. At larger distances, the energy deposited is due to the bremsstrahlung photons, and primarily at electron energies greater than ~100 keV. The specific absorbed fractions of energy due to the bremsstrahlung photons are seen to also be independent of the voxel size. Large fluctuations of the specific absorbed fractions due to the bremsstrahlung photons are also observed due to the small energy deposited by the bremsstrahlung photons, and consequently large coefficient of variations are also seen.

We can take advantage of the independence of Φ with voxel sizes, for both photon and electron sources at target voxels far from the source voxel. Indeed, one could use a point source with concentric spherical shells as an alternative geometry to calculate this decrease of Φ seen for cubical voxel geometries. This spherical geometry is simpler than the three-dimensional voxel geometry and therefore the transport code will run faster allowing for more particles to be transported. Moreover, because of the symmetry in spherical geometry, one will have more particles depositing energy in a given shell, and therefore better statistics in the transport simulations will results. This geometry corresponds to the geometry that is used to calculate point-to-point dose kernels, and therefore specific absorbed fractions results will be equivalent to dose point kernel results for monoenergetic electron and photon sources. At closer distances, however, the voxel-based values of Φ should be retained. The EGS4/PRESTA Monte Carlo particle transport code is also used for particle transport. The spacing between the concentric spheres is taken as 0.1 cm. For photon and electron energies 1 MeV, 1.5 MeV, 2 MeV, and 4 MeV 1,000,000 particles are simulated, and for photon energies between 10 keV and 500 keV and electron energies between 100 and 500 keV, 10,000,000 particles are simulated (no energy deposited by bremsstrahlung is considered for initial electron energies less than 100 keV). The specific absorbed fractions are calculated up to a distance of 60 cm from the source point, which approximately corresponds to the maximal distance between two possible voxels that would be encountered in a clinical environment (the diagonal of a 40-cm field of view). Results of the monoenergetic dose point kernel (specific absorbed fractions) are shown in Figure 7.3 for both photon and electron sources. The coefficients of variation on the photon and electrons results are calculated to be smaller than 5% and 30% respectively. Consequently, very small fluctuations of the dosimetric results are seen.

Using these monoenergetic dose point kernel results, it is possible to verify values of Φ at large distances from the source calculated within the three-dimensional voxel geometries. Figure 7.4 A and B shows graphs of ratios of Φ in the spherical and voxel geometry, for four particle energies (0.02, 0.1, 0.2 and 2 MeV), and for two voxel sizes (0.3 cm and 0.6 cm). These ratios are displayed as a function of the distance index in order to represent the number of voxels crossed instead of the distance crossed. After ~15 to 20 distance indexes, this ratio oscillates within 5% of unity, showing good agreement between the two calculational methodologies. Figure 7.4 C and D shows the same graphs for electron sources. In these graphs, ratios of Φ calculated using the two methods are also displayed as a function of the distance index. The shortest distance between source and target voxels is also shown for some distance index. This information is very useful since, for example, voxels with a distance index of 1, 2, or 3 are in contact with the source voxel, and therefore will have primary electrons reaching them. On the other hand, voxels with a distance index of 4 are separated from the voxel source by one voxel, and consequently depending on the initial electron energy and the voxel size, the target voxel may not receive energy from primary electrons. This is reflected in the graphs of Figure 7.4 C and D where the ratios of Φ are seen to be oscillating around 1 when the shortest distance between source and target voxels is larger than the range of the primary electrons (See Table 7.3). For these two voxel sizes, this means at distance indexes of 4 or higher for 0.1 and 0.5 MeV electrons (shortest voxel-to-voxel distance greater than 0.01 and 0.2 cm, respectively), and distance index of 22 and 8 for voxel sizes of 0.3 and 0.6 cm, respectively (shortest voxel-to-voxel distance greater than 1 cm). It is also noticed that the variations in these ratios around unity are larger for electrons than for photons due to the larger standard deviations in the specific absorbed fractions from bremsstrahlung photons.

The calculated specific absorbed fractions in the spherical geometry can be used to replace the specific absorbed fractions calculated in the voxel geometry at distances where the two methodologies give similar results. This is of interest considering the large uncertainly seen in the calculated absorbed fractions for small voxel sizes at large distances. Consequently, the voxel specific absorbed fraction of energy can be recalculated for both photon and electron sources using both geometries: the cubical voxel geometry at short distances and the spherical shell geometry at larger distances. From graphs in Figure 7.4, it was decided that photon specific absorbed fractions calculated from a spherical geometry will be used for distance indexes greater than 22 (this index corresponds to a target voxel separated from the source voxel by 4 voxels). For electron sources, the spherical specific absorbed fraction data are only used for voxels which cannot be reached by the primary electrons (shortest distance from the source to the target voxel which exceeds the electron range of the primary electrons).

A database of specific absorbed fractions for both photon and electron sources, for twenty-one voxel sizes, and for twelve energies was thus created. It is then possible to use these tables to generate radionuclide S values, given the radionuclide decay scheme data:

$$S(\text{voxel}_k \leftarrow \text{voxel}_h) = \sum_i \Delta_i \, \Phi_i(\text{voxel}_k \leftarrow \text{voxel}_h), \qquad \text{Eq. 7.4}$$

where Δ_i is the mean energy of radiation particle i per nuclear transition and $\Phi_i(\text{voxel}_k \leftarrow \text{voxel}_h)$ is the specific absorbed fraction to target voxel k per emission of radiation particle i from within source voxel h. In this work, the data of Eckerman et al. (*47, 48*) are used in which each beta particle in the radionuclide decay is treated as a discrete spectrum of monoenergetic electrons.

Figure 7.5 gives examples of voxel S values for voxel sizes 0.3 cm and 0.6 cm, for two radionuclides ^{32}P and ^{131}I. These S values are displayed as individual points, indexed to the source-to-target voxel center-to-center distance, to emphasize the discrete nature of the voxel S value. For the 0.3-cm voxel size (Figure 7.5A), within the source voxel itself, the S value is 0.920 mGy MBq^{-1} s^{-1} for ^{131}I and 1.65 mGy MBq^{-1} s^{-1} for ^{32}P (self-dose). S values for the source voxel irradiating its nearest neighboring voxel (center-to-center-distance of 3 mm) are 0.0354 mGy MBq^{-1} s^{-1} for ^{131}I and 0.232 mGy MBq^{-1} s^{-1} for ^{32}P. The cross-voxel S value from each nearest neighbor is thus 4% and 14% of the self-voxel dose for ^{131}I and ^{32}P, respectively. As electrons and beta particles deposit their kinetic energy in the surrounding target voxels, the S value for ^{131}I decreases ~3.5 orders of magnitude at a source-to-target voxel distance of ~0.5 cm. An effective decrease in the rate of change of the voxel S value with increasing distance is evident beyond ~0.5 cm, at which point, the photon component of the emission spectrum becomes the sole contributor to the S value. For ^{32}P, a decrease of ~6 orders of magnitude is evident at a distance of 1.2 cm from the source voxel. Beyond 1.2 cm, the S value for ^{32}P decreases less drastically as bremsstrahlung photons deposit their energy within voxels further from the source.

For the 0.6-cm voxel size (Figure 7.5B), within the source voxel itself, the S value is 0.131 mGy MBq^{-1} s^{-1} for ^{131}I and 0.324 mGy MBq^{-1} s^{-1} for ^{32}P. The cross-voxel S value from each nearest neighbor is ~2% of the self-voxel S value for ^{131}I and ~8% for ^{32}P, respectively. For distances exceeding 1.0 cm for ^{131}I and for distances exceeding 2.0 cm for ^{32}P, the S values for 6-mm voxels are comparable to those for 3-mm voxels at equivalent source-to-target voxel separations.

A C program was written to tabulate voxel S values for any radionuclides, and for any voxel sizes between 0.05 cm and 1.0 cm. An interpolation schema was developed for voxel sizes for which specific absorbed fractions were not tabulated. For both photon and electron sources, specific absorbed fractions within target voxels located at a distance from the source voxel where Φ is independent of the voxel size are calculated using values of Φ obtained in spherical geometry. As seen earlier, this corresponds to voxels with distance indexes greater than 22 in the case of photon sources, or to voxels that can not be reached by the primary electrons in the case of electron sources.

For target voxels close to the source, results of specific absorbed fractions for photon sources and for electron sources are considered separately. In addition, the interpolation of the self-absorbed fractions of energy is performed differently if the target is the source or not. Figure 7.6 shows the variation of the self-absorbed fractions of energy as a function of the voxel size for all twelve energies. These variations are observed to be roughly linear for all energies, and therefore, a simple linear interpolation of the absorbed fractions can be used to derive self-absorbed fraction for a voxel size not considered in the transport calculations. This interpolation is verified in

Table 7.4 by interpolating the absorbed fractions for voxel sizes from which we have transport results. For example, the absorbed fraction of energy within the voxel size 0.5 cm is interpolated between results for voxel sizes 0.45 cm and 0.55 cm. Using this extrapolation schema, very good agreement is seen for all initial photon energies.

For photon sources, and for target voxels different than the source voxel, extrapolations of the specific absorbed fractions are performed using the function ($\Phi \times$ distance^2), where Φ is the specific absorbed fraction of energy, and distance is the source-to-target voxel center-to-center distance. Figure 7.7 shows variations of ($\Phi \times$ distance^2) with voxel size for voxels directly adjacent to the source, and for all twelve initial photon energies considered in the transport. In this figure, one can observe linear variations of the logarithm ($\Phi \times$ distance^2) with voxel size for initial photon energies less than 100 keV, and linear variations of ($\Phi \times$ distance^2) with voxel size for photon initial energies greater than 100 keV. Figure 7.8 shows the same results, for voxels located at a distance index of 10. Consequently, to derive photon specific absorbed fractions for target voxels different than the source voxel, linear interpolation of the logarithm of ($\Phi \times$ distance^2) with voxel size are performed for initial photon energies less than 100 keV. For initial photon energies greater than 100 keV, linear interpolation of the ($\Phi \times$ distance^2) with voxel size are performed. An estimation of the error associated with such an interpolation can be calculated using voxel sizes used in the transport simulations. Table 7.5 shows the percentage error of performing these interpolations for voxel sizes 1 cm apart, and for the target voxels with distance indexes of 1 and 10, and for four voxel sizes. For both of these voxels, very good agreement is seen between the interpolated and the Monte Carlo calculated specific absorbed fractions of energy. Only when the absorbed fractions are very small, (i.e. for low energies and for voxel sizes distant from the source), are large differences seen (10 to 50 %). However, since these differences correspond to absorbed fractions on the order of 10^{-7} to 10^{-8}, they are associated with large coefficient of variations. Consequently, for a better analysis of these differences, better statistic on the results need to be achieved which correspond to an increase in the number of particles transported during the Monte Carlo simulations.

For electron self-specific absorbed fractions (source voxel equal target voxel), an interpolation with voxel size is linearly performed on the absorbed fractions of energy. Figure 7.9 shows the variations of the self-absorbed fractions of energy as a function of the voxel size for several initial electron energies. These variations are seen to be relatively linear with the voxel size, except for small voxel sizes. The error introduced when such interpolation is used is reflected in Table 7.6. In this table, the percentage error of an extrapolation between results obtained for voxel sizes separated by 1 cm are given for all initial electron energies. The difference is for all energies and voxel sizes less than 5%, and in general less than 1%.

The last interpolations that has not been mentioned is for electron sources when the source and target voxels are different, and when their shortest distance is less than the range of the electron. In this case, the interpolation with voxel size is performed on the logarithm of the absorbed fractions. In Figure 7.10 the variations of the absorbed fractions with voxel size, for target voxels with distance indexes of 1 and 2 are presented in semi-logarithm graphs for several initial electron energies. In these graphs, the variations of the logarithm of the absorbed fraction are observed to be relatively linear with voxel sizes. Note that the fluctuations observed can be attributed to the low number of particles used during the transport. An estimation of the error attributed to this interpolation is presented in Table 7.7 for four voxel sizes and two distance indexes. Very good agreement is seen for the closest target voxel from the source (distance index of 1). For the second closest voxel from the source (distance index of 2), some large differences are seen for low energies and for small cube sizes. These differences are associated with low absorbed fractions of energy (10^{-6} to 10^{-4}), and consequently to results with large coefficient of variations. In order to have better results in the interpolation schema, more particles need to be simulated during the Monte Carlo transport.

Using this interpolation schema (see Table 7.8) of the specific absorbed fractions of energy with voxel size, it is possible to give radionuclide S values for any voxel size between 0.05 cm and 1.0 cm. In order to estimate the maximum errors on the calculation of the S values of these interpolations, S values were calculated for voxel sizes 0.2 cm, 0.4 cm, 0.6 cm, and 0.8 cm by interpolating the specific absorbed fractions of energy between voxel sizes 0.05 cm above, and 0.05 cm below the desired voxel size. At the same time, the S values were calculated for the four interpolated voxel sizes using the transport data. The percentage differences are presented in Table 7.9 for ^{32}P and ^{131}I. generally very small differences are seen for all voxel positions and all voxel sizes, except for ^{32}P at 0.20 cm. Since ^{32}P is a pure beta emitter the differences are coming from the electron transport results. At this voxel dimension, the absorbed fractions are very low, and therefore coefficient of variations are very high. For voxel dimensions smaller than 0.40 cm, more particles need to be transported during the Monte Carlo simulations to improve the statistics of the absorbed fractions results. It can, however, be noticed that these differences are for extrapolations between voxel sizes separated by 1.0 cm. Therefore, they represent an overestimation of the error that one would have if the extrapolations were performed between voxel sizes separated by only 0.05 cm.

The C program written for the tabulation of voxel S values is given in Appendix I. The user input is simply the voxel size and the radionuclide of interest. The user also supplies either the maximum distance for which S values are to be tabulated, or the dimension $N_0$of the square matrix of the voxel S values. The limitations of this program are the voxel size that has to be between 0.05 cm and 1.0 cm, and the maximal distance from the source cannot exceed 60 cm. The program gives two files, one with the S values as a function of the source-to-target voxel center-to-center distance, and the other with the S values as a function of the (I, J, K) position of the target voxel. The output files have distinct names with the voxel size and radionuclide indicated. An example of these two files is given in Appendix J for a 5 mm voxel size for ^{131}I. For this example, the file names are "S_value_DIST_0.50-cm_p-32.dat" and "S_value_IJK_0.50-cm_p-32.dat", for the S values as a function of the distance from the source and as a function of the (I, J, K) position of the target voxel, respectively.

In case of potential applications of these S values with autoradiographic data, specific absorbed fractions were calculated using the transport code for a voxel size of 100 μm. It is therefore possible to run the S value program for such a voxel size, but no interpolations can be performed for voxel sizes smaller than 0.05 cm. This limitation is due to the larger errors expected at these very small voxel sizes. These interpolations await more Monte Carlo simulations to be performed at smaller voxel sizes (below 500 μm).

Voxel S values for noncubical geometries

In some situations, radiopharmaceutical images may be acquired for a geometry composed of noncubical voxels. In these cases, a precalculated database of voxel S values would be difficult to maintain which would accommodate all possible combinations of in-plane pixel resolution and image slice thickness. In autoradiography studies, noncubical voxels are almost always obtained in which the slice thickness exceeds the pixel dimensions. For these situations, voxel S values must be generated for the particular sample being analyzed or technique being employed.

As an example of the use of noncubical voxel S values, additional simulations for ^{131}I in a voxel array set were made with each voxel having dimensions of 50 μm x 50 μm x 1 mm corresponding to activity data sets with an in-plane resolution of 50 μm and an effective slice thickness of 1 mm. The computational demands of both smaller voxel dimensions and the loss of cubical symmetry required a modified transport geometry. For this S value data set, the source voxel was located within the corner of a target voxel array 219 x 219 voxels in the XY plane (corresponding to the 50 μm x 50 μm dimensions) and 9 voxels in the Z plane (corresponding to the 1 mm dimensions). These voxel S values for ^{131}I are used to assess isodose contours in the second example of the following section.

Applications to Clinical Data

In this section, two illustrative examples are given in which voxel S values are used to analyze three-dimensional activity data sets yielding isodose contours and dose volume histograms. In the first example, voxel S values for ^{32}P within 0.6-cm cubical voxels given in Appendix A are used. The second example uses a data set obtained from autoradiography in which activity in noncubical voxels are assessed. In this case, a specific voxel S value data set for ^{131}I was generated for use in the dosimetry analysis.

Example 1 - Bremsstrahlung SPECT Image from ^{32}P

This particular example utilizes data from a clinical Phase I therapeutic trial in which a patient with nonresectable liver metastases is treated by direct interstitial injection of 629 MBq (17 mCi) of colloidal ^{32}P chromic phosphate into the tumor-bearing region under CT guidance. An injection of macroaggregated albumin is given prior to the therapy injection to block the vasculature surrounding the tumor; consequently, the activity within the treated region generally clears by physical decay only. Quantification of the activity distribution within the liver is obtained through quantitative SPECT imaging of bremsstrahlung photons generated in the slowing-down of the ^{32}P beta particles. Further details of the imaging methodology are found in References *197* and *198*. Fifteen image slices of 64 x 64 pixels each were considered in this particular image set, each with a nominal voxel size of ~0.6-cm. Figure 7.11 A and B show the original SPECT images for slices #3 and #10, respectively.

Following the conversion of counts per image voxel to values of cumulated activity per image voxel (*197*), Equation 7.2 was applied to all voxels in the image using the ^{32}P voxel S values given in Appendix A. The resulting isodose distributions for slice #3 and #10 of the 15-slice array are also shown in Figure 7.11 A and B, respectively. Slice #3 shows maximum localization of the activity within the liver tumor, while slice #10 outlines activity in the adjacent spleen. Figure 7.11 A and B give isodose contours for 10, 30, 50, 70, and 90 percent of the maximum voxel dose which was estimated to be 415 Gy. In this analysis, a voxel count threshold was applied to determine those voxels within the image which were to be used in both volume and activity determinations. More rigorous methods of isolating regions of interest within a SPECT data set are now available such as the fusion of SPECT and CT images (*199*).

In addition to isodose contours, one may view three-dimensional distributions of absorbed dose by constructing a dose-volume histogram (DVH) which shows relative fractions of the target region which receive specific ranges of absorbed dose. For example, Figure 7.12 displays a DVH for the liver in this example problem. While the average dose to liver was estimated to be 43.7 Gy, tissue regions within the liver are shown to have received doses ranging from 8 Gy to 200 Gy. A very small percentage (individual tissue voxels) of the liver tissue received doses in excess of 200 Gy (not shown in Figure 7.12). The DVH may also be displayed as a cumulative distribution as shown in Figure 7.13 for both the liver and the spleen. In this plot, the ordinate gives the cumulative fraction of target tissue receiving an absorbed dose in excess of the corresponding dose value on the abscissa. Figure 7.13 shows that tissues within the spleen receive a more uniform distribution of absorbed dose than tissues within the liver. The average dose to the spleen was estimated to be 18.6 Gy.

Example 2 - Autoradiograph of a Mouse Renal Cell Carcinoma Treated with ^{131}I labeled Antibody

In this second example, we utilize data from autoradiographs taken from an A6H tumor xenograft (mouse renal cell carcinoma) treated with an ^{131}I-labeled monoclonal antibody. Activity arrays obtained from three separate autoradiographs were provided with two additional arrays generated via interpolation. Correspondingly, a total of five contiguous sections were available for dosimetry calculations each spaced by 1 mm. Cumulated activity values per voxel were derived from direct absorbed dose measurements with calibrated micro-TLDs (*200, 201*). In this work, micro-TLDs were implanted within the tumor xenografts prior to radionuclide administration. The micro-TLDs were removed after the tumor was sectioned on a microtome and their light output was measured by conventional means. The biological half-times were assumed to be identical for all voxels. Activity distributions registered on the autoradiographic film were converted to idealized cumulated activity per voxel. The film gray-scale was calibrated with standards of known cumulated activity. The in-plane resolution was 50 μm x 50 μm for an array size of 256 x 256 voxels per slice. Figure 7.14 shows the distribution of activity as determined by the micro-TLD measurements for the first of five tumor slices. Dose distributions were subsequently generated using the three-dimensional array of voxel S values for ^{131}I generated specifically for this voxel geometry. Isodose contours are also shown.

Discussion and Conclusions

A variety of methods have been reviewed which facilitate the calculation of three-dimensional profiles of absorbed dose for nonuniform distributions of activity within targeted and nontargeted tissue regions. Dosimetry calculations for tissue regions of dimensions ranging from millimeters to hundreds of micrometers represent one of the levels of internal dosimetry of greatest potential for advancing patient-specific dose estimates. Three broad tools that can be used for voxel dosimetry calculations have been discussed: dose point-kernel convolution methods, direct Monte Carlo radiation transport, and voxel S values. Voxel S values (as defined here) and dose point-kernels may be used only when tissue inhomogeneities do not substantially affect the dose calculations. Direct Monte Carlo radiation transport offers a method for handling regional changes in tissue composition and density. This chapter also emphasizes that nonuniform distributions of activity can be accommodated within the MIRD schema provided (i) the activity distribution can be quantitatively measured at the voxel level, and (ii) tabulations of radionuclide S values for identical voxel dimensions are available.

The variations of the voxel specific absorbed fractions of energy with voxel size were investigated for voxel sizes between 0.05 cm and 1.0 cm. An interpolation schema was developed and a C program was developed to generate voxel S values for any radionuclide and for any voxel size between 0.05 cm and 1.0 cm. This research therefore fulfills the lack of tabulated voxel S values that was limiting the development of this method of dosimetry for nonuniform activity distribution.

In conclusion, the voxel S-value approach offers an accurate and computationally efficient tool to be used with the MIRD schema for calculating absorbed dose from nonuniform source distributions within homogeneous media. Examples are provided that illustrate its use in clinical applications.

Table 7.1: Example of voxel coordinate with same source-to-target voxel center-to-center distance, but with different arrangement when compare to the source voxel.

Distance	**Position #1**	**Position #2**
3 × (Voxel Size)	(0, 0, 3)	(2, 2, 1)
$\sqrt{17}$ × (Voxel Size)	(2, 2, 3)	(0, 1, 4)
$3\sqrt{2}$ × (Voxel Size)	(1, 1, 4)	(0, 3, 3)
5 × (Voxel Size)	(0, 0, 5)	(0, 3, 4)

Table 7.2: List of distances of the ten closest voxels from the source voxel for four voxel sizes.

Distance Index	**3D Coordinate***	**Voxel Size (cm)**			
		0.20	**0.40**	**0.60**	**0.80**
1	(1, 0, 0)	0.2000	0.4000	0.6000	0.8000
2	(1, 1, 0)	0.2828	0.5657	0.8485	1.1314
3	(1, 1, 1)	0.3464	0.6928	1.0392	1.3856
4	(2, 0, 0)	0.4000	0.8000	1.2000	1.6000
5	(2, 1, 0)	0.4472	0.8944	1.3416	1.7889
6	(2, 1, 1)	0.4899	0.9798	1.4697	1.9596
7	(2, 2, 1)†	0.6000	1.2000	1.8000	2.4000
8	(3, 1, 1)	0.6633	1.3266	1.9900	2.6533
9	(2, 2, 2)	0.6928	1.3856	2.0785	2.7713
10	(3, 2, 1)	0.7483	1.4967	2.2450	2.9933

* The voxels with symmetric coordinates are not given.

† The target voxel with coordinate (3, 0, 0) is also at the same distance.

Table 7.3: Electron CSDA range in tissue (*83*).

Energy (MeV)	R_{CSDA} (cm)
0.01	0.0002
0.015	0.0005
0.0.2	0.0008
0.03	0.0017
0.05	0.0042
0.1	0.0138
0.2	0.0431
0.5	0.1700
1	0.4200
1.5	0.6800
2	0.9410
4	1.9600

Table 7.4: Percentage error associated with the voxel size extrapolation of photon self-specific absorbed fractions. The extrapolation is performed using results for voxel sizes 1 cm apart, and is compared to the simulated results. The voxel size given in this table corresponds to the extrapolated voxel size.

Energy	Voxel Size (cm)			
(MeV)	0.20	0.40	0.60	0.80
0.010	1.2	0.4	0.2	0.1
0.015	0.3	0.1	0.1	0.1
0.020	0.7	0.1	0.0	0.1
0.030	0.4	0.3	0.2	0.1
0.050	2.0	1.2	0.1	0.3
0.100	2.3	0.3	0.0	0.3
0.200	0.2	0.8	1.2	0.5
0.500	0.1	1.9	0.3	0.3
1.000	4.3	0.7	0.9	1.3
1.500	2.6	0.8	3.5	0.2
2.000	5.8	0.4	0.1	1.2
4.000	9.2	3.8	0.6	0.5

Table 7.5: Percentage error associated with the voxel size extrapolation of photon specific absorbed fractions within target voxels with distance indexes of 1 and 10. The extrapolation is performed using results for voxel sizes 1 cm apart, and are compared to the simulated results. The voxel size given in this table corresponds to the extrapolated voxel size.

Energy (MeV)	**Voxel Size (cm)**							
	Distance index #1				**Distance index #10**			
	0.20	**0.40**	**0.60**	**0.80**	**0.20**	**0.40**	**0.60**	**0.80**
0.010	0.3	0.2	0.2	0.1	0.9	8.1	11.0	50.9
0.015	0.0	0.1	0.1	0.0	0.7	1.7	2.3	2.1
0.020	0.5	0.1	0.0	0.1	2.9	0.5	0.2	0.1
0.030	1.1	0.8	0.1	0.0	0.5	1.8	0.3	0.0
0.050	0.5	1.5	0.4	0.0	2.9	3.4	1.2	1.6
0.100	1.7	0.1	0.3	0.6	5.1	0.2	1.7	0.2
0.200	0.5	0.3	0.4	0.6	2.5	2.8	1.7	0.5
0.500	2.1	0.7	0.8	0.5	0.9	0.8	0.7	0.2
1.000	0.9	0.8	0.0	1.1	1.3	2.6	1.0	2.4
1.500	1.6	0.4	1.4	1.3	3.8	3.7	2.2	1.3
2.000	2.4	1.3	0.3	0.5	0.4	1.3	1.7	4.2
4.000	7.8	0.4	1.8	0.1	6.2	0.0	3.9	0.5

Table 7.6: Percentage error associated with the voxel size extrapolation of electron self-specific absorbed fractions. The extrapolation is performed using results for voxel sizes 1 cm apart, and is compared to the simulated results. The voxel size given in this table corresponds to the extrapolated voxel size.

Energy	**Voxel Size (cm)**			
(MeV)	**0.20**	**0.40**	**0.60**	**0.80**
0.010	0.0	0.0	0.0	0.0
0.015	0.0	0.0	0.0	0.0
0.020	0.0	0.0	0.0	0.0
0.030	0.1	0.0	0.0	0.0
0.050	0.1	0.1	0.0	0.0
0.100	0.5	0.3	0.1	0.0
0.200	1.4	0.6	0.1	0.1
0.500	5.3	0.6	0.2	0.1
1.000	2.8	1.1	0.3	0.1
1.500	3.6	1.1	0.2	0.2
2.000	3.4	0.7	0.3	0.7
4.000	3.6	0.8	0.0	0.0

Table 7.7: Percentage error associated with the voxel size extrapolation of electron specific absorbed fractions within target voxels with distance index 1 and 2. The extrapolation is performed using results for voxel sizes 1 cm apart, and is compared to the simulated results. The voxel size given in this table corresponds to the extrapolated voxel size.

Energy (MeV)	**Voxel Size (cm)**							
	Distance Index #1				**Distance index #2**			
	0.20	**0.40**	**0.60**	**0.80**	**0.20**	**0.40**	**0.60**	**0.80**
0.010	7.9	9.2	1.4	2.2	-	-	-	-
0.015	1.9	10.5	7.4	5.8	-	-	-	-
0.020	1.9	14.7	9.3	4.3	-	-	-	-
0.030	4.2	14.7	2.9	6.0	7.8	-	-	-
0.050	3.0	14.9	5.5	7.0	64.1	13.9	18.5	93.8
0.100	4.3	10.7	4.0	1.8	1.1	26.1	43.5	8.2
0.200	2.9	7.2	1.3	2.4	6.7	17.7	9.7	24.3
0.500	0.7	0.5	1.0	0.5	3.0	0.9	2.7	1.1
1.000	8.2	0.8	0.4	0.6	12.5	0.5	1.4	0.3
1.500	3.4	2.2	1.1	0.8	5.4	2.5	0.8	0.2
2.000	3.2	1.4	0.7	0.0	2.9	3.1	1.4	0.2
4.000	3.8	0.6	0.1	0.5	2.8	0.1	0.8	1.2

Table 7.8: Summary of the extrapolation schema used to derive specific absorbed fractions of energy for voxel sizes from which Monte Carlo transport results are not available.

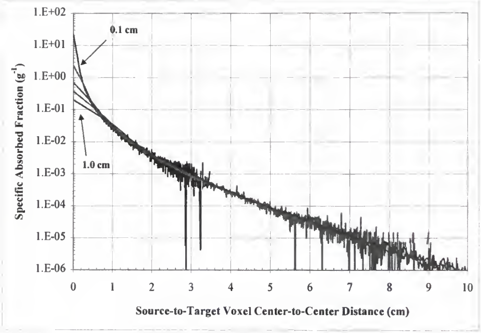
	Photon Sources	**Electron Sources**
S = T	Linear interpolation of the self-absorbed fraction with voxel size	Linear interpolation of the self-absorbed fraction with voxel size
S ≠ T **(short distances[*])**	If $E \leq 100$ keV: Linear interpolation of the logarithm of ($\Phi \times dist^2$) with voxel size[†] If $E > 100$ keV: Linear interpolation of ($\Phi \times dist^2$) with voxel size[†]	Linear interpolation of the absorbed fractions to a given (I, J, K) voxel with voxel size
S ≠ T **(large distances[*])**	Use specific absorbed fractions calculated in spherical geometry	Use specific absorbed fractions calculated in spherical geometry

[*] For photon sources, short distances mean voxels with distance indexes smaller than 22. For electron sources, short distances means voxels that can be reach by primary electrons.

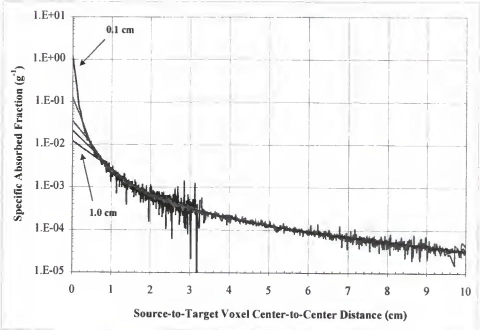
[†] The variable dist is the source-to-target voxel center-to-center distance.

Table 7.9: Percentage error associated with the voxel size extrapolation of S values for two radionuclides, and four different voxel sizes. The extrapolation is performed using specific absorbed fraction results for voxel sizes 1 cm apart, and is compared to the simulated results. The voxel size given in this table corresponds to the extrapolated voxel size.

Distance Index	**Voxel Size (cm)**							
	^{32}P				**^{131}I**			
	0.20	**0.40**	**0.60**	**0.80**	**0.20**	**0.40**	**0.60**	**0.80**
1	3.8	0.8	0.2	0.0	2.3	0.1	0.1	0.1
2	4.8	1.0	0.4	0.5	0.5	1.7	0.4	0.6
3	9.1	1.4	0.9	0.1	2.4	1.8	0.8	0.1
4	12.4	1.5	1.9	0.2	2.4	1.3	0.3	0.3
5	17.8	9.8	14.6	0.4	2.9	0.6	0.1	0.4
6	20.0	9.5	12.3	0.1	1.5	0.5	1.2	0.2
7	23.2	6.4	2.3	0.2	0.9	0.8	0.0	0.3
8	32.6	40.4	9.6	0.0	1.4	0.1	0.1	1.4
9	34.9	3.7	0.0	0.0	0.8	1.9	0.1	0.5
10	40.5	1.0	0.0	0.0	2.4	0.9	0.4	0.2
11	41.0	2.0	0.0	0.0	0.6	0.1	0.1	0.2
12	41.4	2.4	0.0	0.0	0.0	0.1	0.1	0.1
13	52.9	0.9	0.0	0.0	0.8	1.2	0.3	1.0
14	46.7	0.6	0.0	0.0	0.7	0.8	1.0	0.1
15	30.2	0.2	0.0	0.0	0.2	3.4	0.7	1.3
16	11.8	0.0	0.0	0.0	2.1	0.2	0.1	0.0
17	16.9	0.0	0.0	0.0	0.8	1.0	1.2	0.0
18	46.5	0.0	0.0	0.0	2.9	1.0	0.8	0.0
19	63.3	0.0	0.0	0.0	0.2	1.7	2.6	0.0
20	80.6	0.0	0.0	0.0	1.1	2.8	0.4	0.0
21	102.6	0.0	0.0	0.0	0.3	0.3	2.6	0.0
22	121.0	0.0	0.0	0.0	3.1	0.7	0.6	0.0

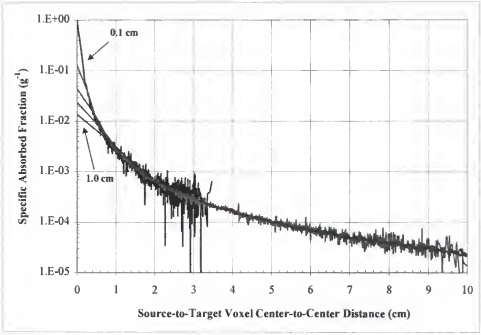


(A)

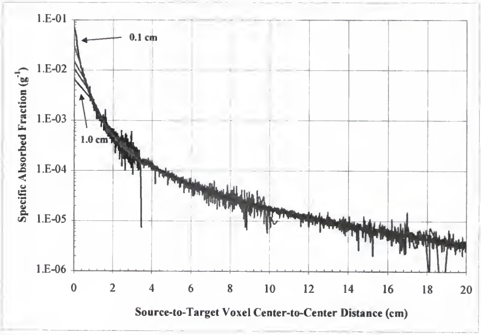


(B)

Figure 7.1: Graphs of specific absorbed fractions of energy versus source-to-target voxel center-to-center distance for photon sources of energy (A) 0.02 MeV, (B) 0.1 MeV, (C) 0.5 MeV, and (D) 2 MeV. Five voxel sizes are represented 0.1 cm, 0.3 cm, 0.55 cm, 0.75 cm, and 1.0 cm.

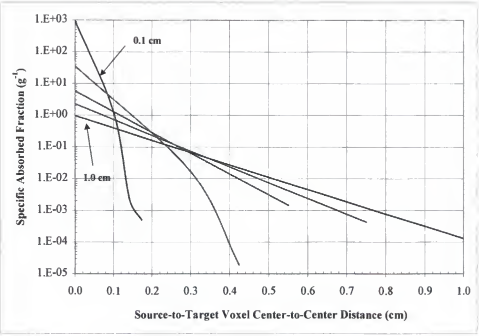


(C)

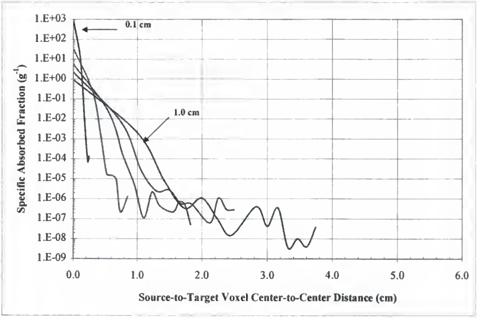


(D)

Figure 7.1: continued.

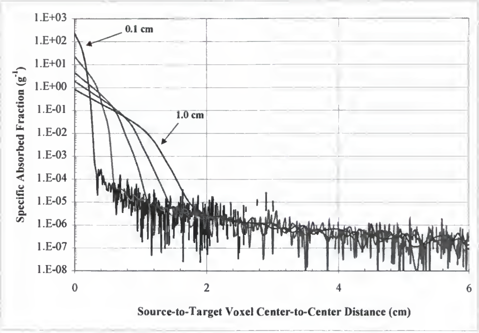


(A)

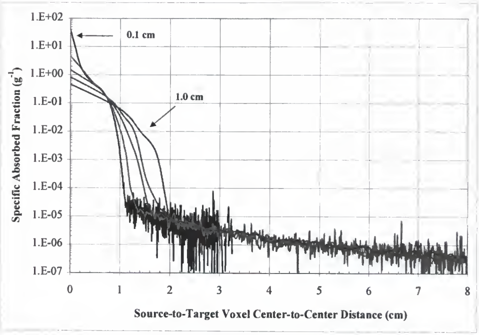


(B)

Figure 7.2: Graphs of specific absorbed fractions of energy versus source-to-target voxel center-to-center distance for electron sources of energy (A) 0.02 MeV, (B) 0.1 MeV, (C) 0.5 MeV, and (D) 2 MeV. Five voxel sizes are represented 0.1 cm, 0.3 cm, 0.55 cm, 0.75 cm, and 1.0 cm.



(C)



(D)

Figure 7.2: continued.

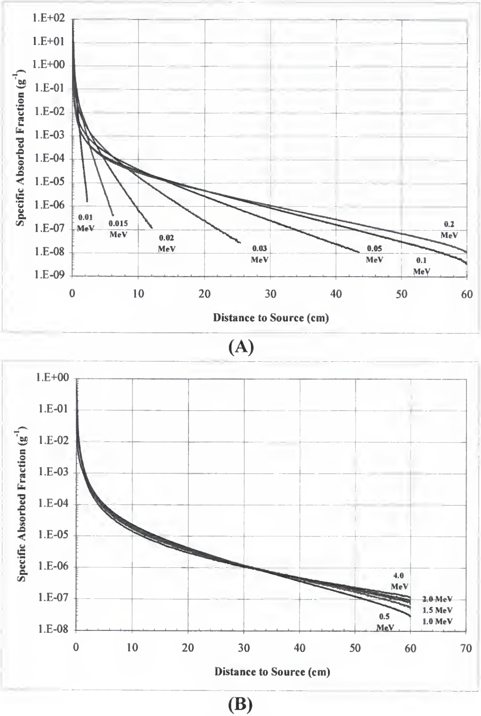
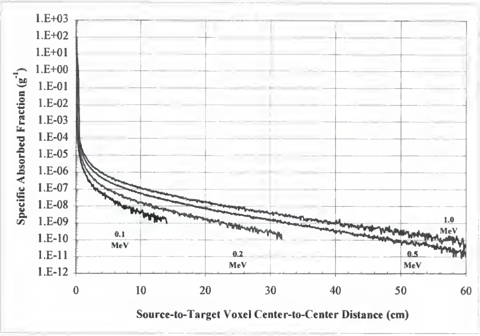
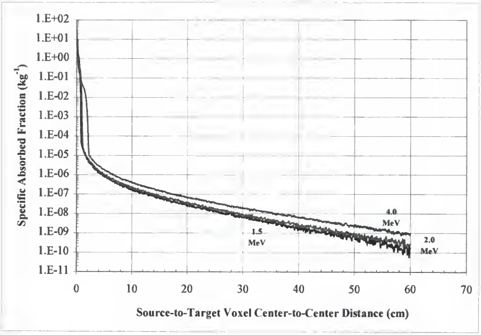


Figure 7.3: Graphs of specific absorbed fractions of energy versus source to target distance calculated using a point source and concentric spheres separated by 0.1 cm. Photon sources are represented in graphs (A) and (B), and electron sources in graphs (C) and (D).

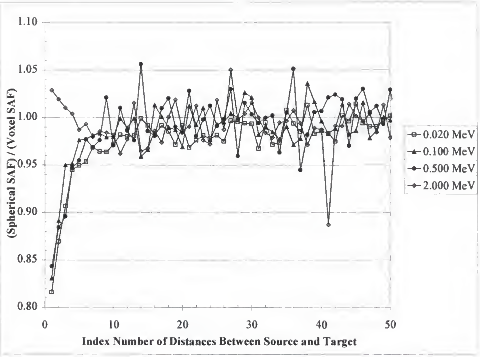


(C)

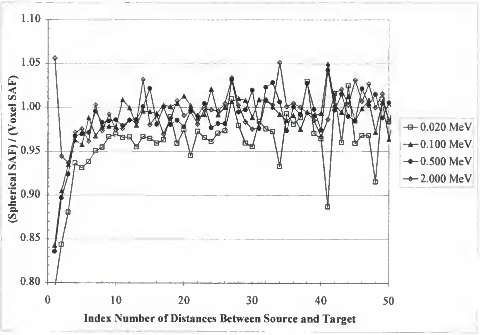


(D)

Figure 7.3: continued.



(A)



(B)

Figure 7.4: Ratios of specific absorbed fractions calculated using spherical geometry and cubical geometry for photon sources (graphs (A) and (B)) and for electron sources (graphs (C) and (D)). Two voxel sizes are used, 0.3 cm for graphs (A) and (C), and 0.6 cm for graphs (B) and (D).

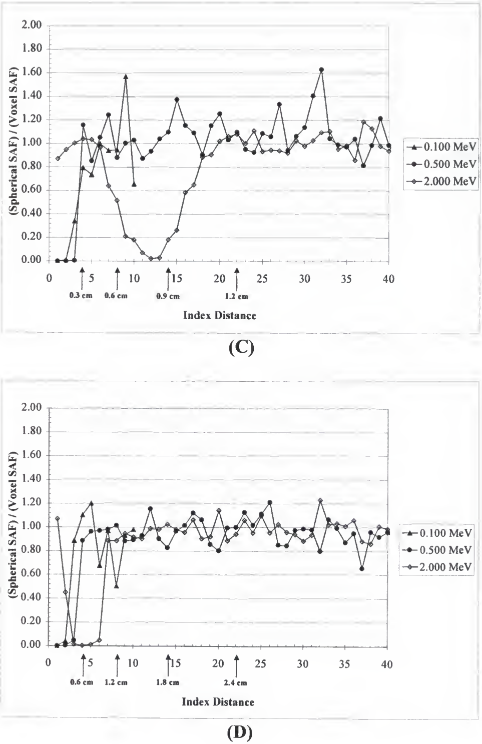
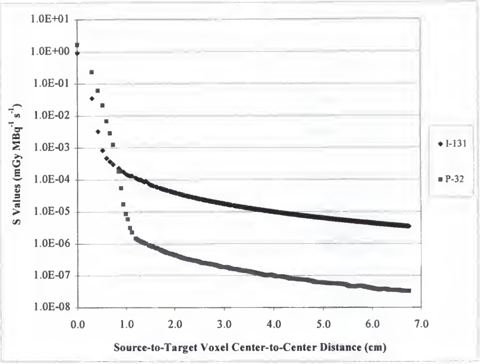
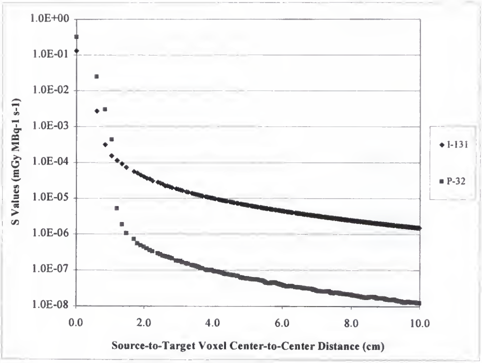


Figure 7.4: continued.

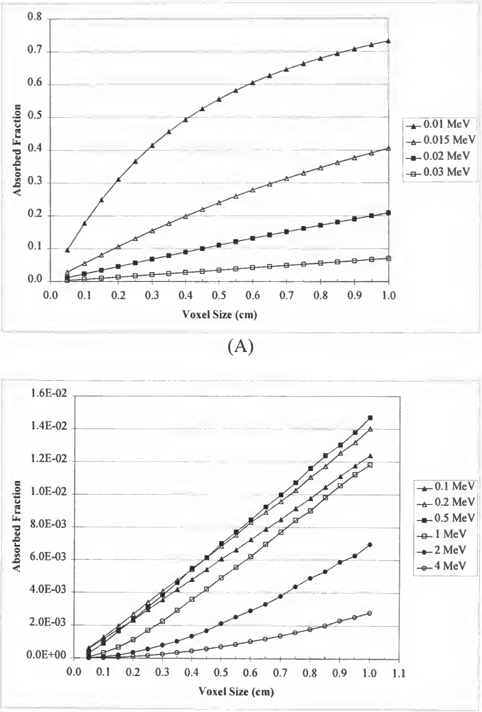


(A)



(B)

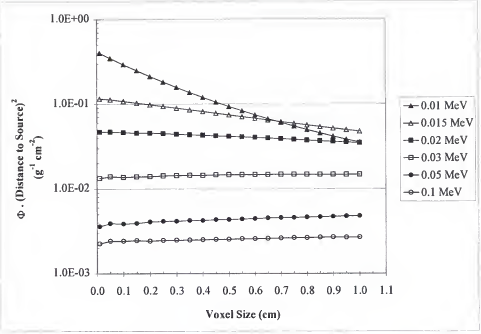
Figure 7.5: Radionuclide S values for ^{32}P and ^{131}I within (A) 0.3 cm and (B) 0.6 cm voxels.



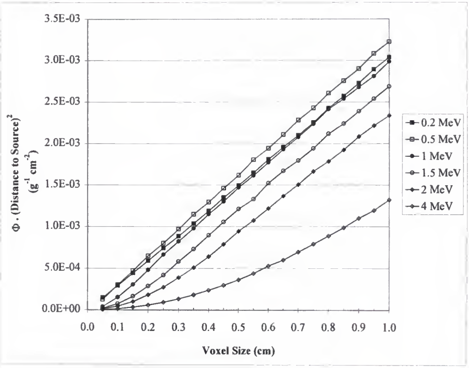
(A)

(B)

Figure 7.6: Variations of the photon self-absorbed fractions with voxel size for (A) initial photon energy less than 100 keV and (B) initial photon energy greater than 100 keV.

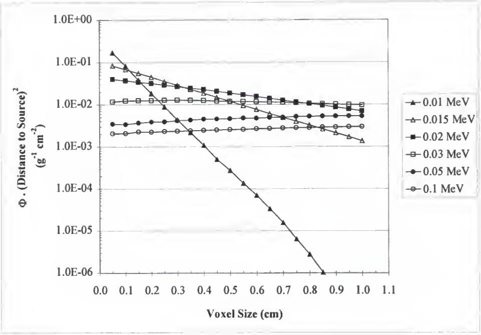


(A)

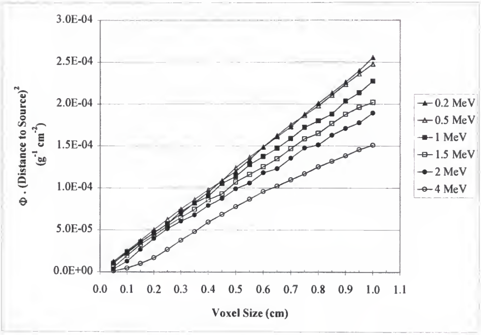


(B)

Figure 7.7: Variations of (Φ × distance^2) to the voxel directly adjacent to the source (distance index 1) with voxel size for photon sources and for (A) initial photon energies less than 100 keV and (B) initial photon energies greater than 100 keV.



(A)



(B)

Figure 7.8: Variations of ($\Phi \times \text{distance}^2$) to voxels target with a distance index of 10 with voxel size for photon sources and for (A) initial photon energy less than 100 keV and (B) initial photon energy greater than 100 keV.

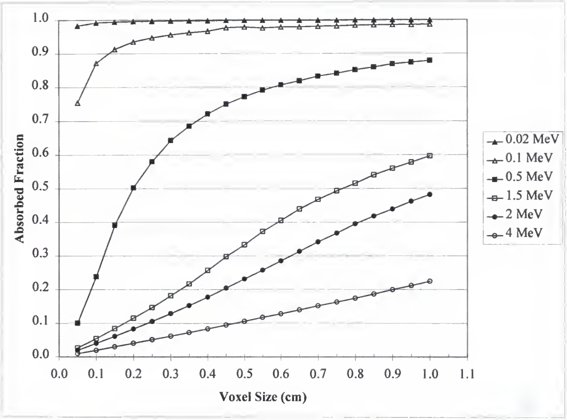
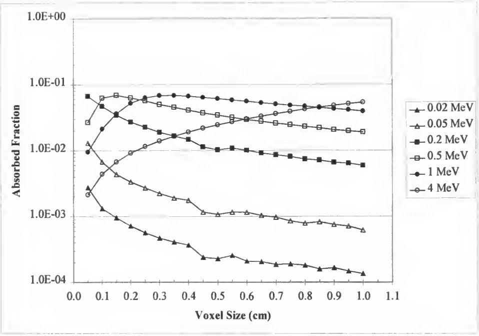
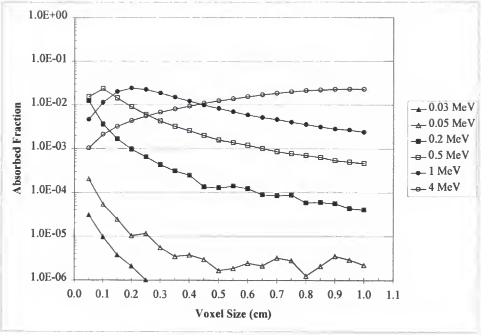


Figure 7.9: Variations of the electron self-absorbed fractions with voxel size for six initial electron energies.



(A)



(B)

Figure 7.10: Variations of the electron absorbed fractions to voxel targets (A) directly adjacent to the source voxel, and (B) with a distance index of 2.

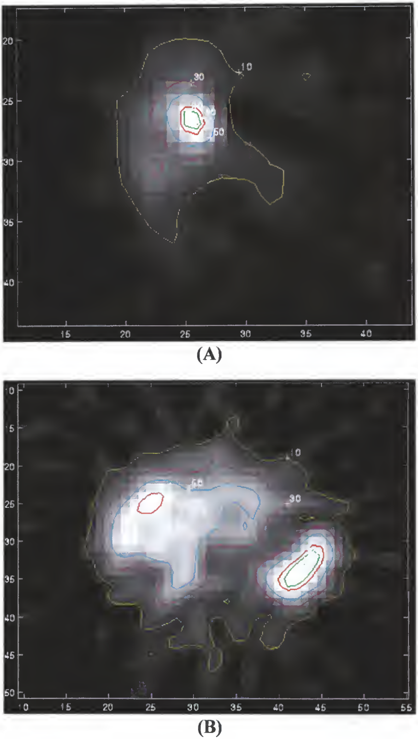


Figure 7.11: Bremsstrahlung SPECT images from a 629 MBq injection of colloidal ^{32}P chromic phosphate in the liver of patient with nonresectable liver metastates. (A) SPECT Slice #3 showing maximal localization of activity; (B) SPECT Slice #10 showing unintended transfer of activity to the spleen. Relative isodose curves are shown for 10% (yellow), 30% (magenta), 50% (blue), 70% (red), and 90% (green) of the maximum voxel dose estimated to be 415 Gy. Pixel locations are indicated for both abscissa and ordinate.

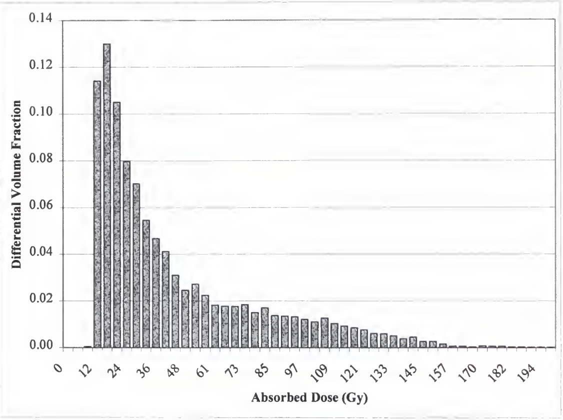


Figure 7.12: Differential dose-volume histogram within the liver of a patient treated with 629 MBq of ^{32}P chromic phosphate as determined by quantitative bremsstrahlung SPECT imaging and ^{32}P voxel S values. Abscissa values are rounded to the nearest Gy.

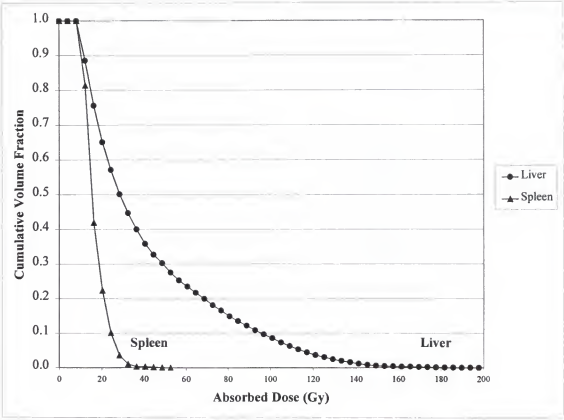


Figure 7.13: Cumulative dose-volume histogram within the liver and spleen of a patient treated with 629 MBq of ^{32}P chromic phosphate as determined by quantitative bremsstrahlung SPECT imaging and ^{32}P voxel S values.

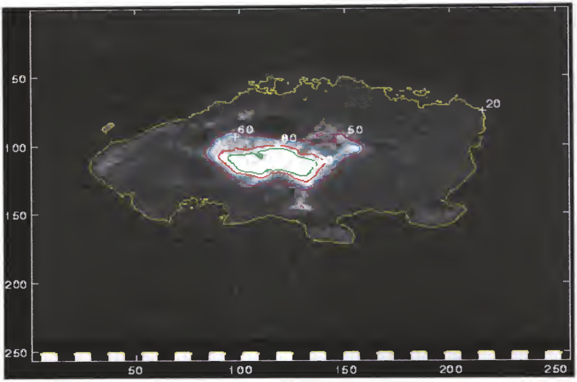


Figure 7.14: Distribution of ^{131}I monoclonal antibody within an A6H tumor xenograft (mouse renal cell carcinoma) as determined by implanted microTLDs. Relative isodose contours within the tumor are shown as determined by the MIRD schema using ^{131}I voxel S values for voxels 50 µm x 50 µm x 1 mm in dimension. Curves are shown for 10% (yellow), 30% (magenta), 50% (blue), 70% (red), and 90% (green) of the maximum voxel dose estimated to be 14.4 Gy. Pixel locations are indicated for both abscissa and ordinate.

CHAPTER 8
CONCLUSIONS AND FUTURE WORK

Three different aspects of nuclear medicine dosimetry have been considered in this dissertation. First, for diagnostic nuclear medicine, five new pediatric models of the head and brain have been developed based on a recently published adult MIRD head and brain dosimetric model (*3*). These models include new intra-brain regions, the incorporation of eyes, a more detailed facial skeleton, and a separate neck region. They were coupled to the Monte Carlo transport code EGS4 to simulate the transport of monoenergetic photons and electrons. Absorbed fractions of energy and radionuclide S values were tabulated as a result of this coupling. Fourteen different sources, sixteen targets, twelve monoenergetic energies, and twenty-two radionuclides were considered. These dosimetric data will improve head and brain dosimetry in nuclear medicine procedures and support the need for suborgan brain dosimetry for current and developing neuroimaging agents. Moreover, these models represent an improvement for external dosimetric calculations due to the inclusion of a separate neck region. This separate neck region will circumvent the need for repositioning the thyroid gland when the model is used to estimate thyroid doses from external radiation fields.

Future work in the area of head and brain dosimetry for nuclear medicine diagnostic procedures include the addition of new brain subregions. The inclusion of new subregions will be dictated by future development of radiopharmaceuticals with high uptake within regions not considered in the current model.

The trend in the area of dosimetry for nuclear medicine diagnostic procedures is towards the use of digital imaging as input for radiation transport code (*202*). S values tabulations performed using this methodology are specific to the patient from whom the digital images are taken. Consequently, they generally do not represent an average individual. One needs to keep in mind that the S values tabulated for use in dose calculations performed for diagnostic nuclear medicine procedures are primarily intended for radiation protection purposes and therefore need to be representative of an average individual.

In the area of bone dosimetry, a new transport of electron in trabecular bone was presented. This model was based on the chord length distribution measured by Spiers (*54-56*), and allowed for the full three-dimensional transport of the electrons. For the electron transport simulations, the EGS4-PRESTA Monte Carlo transport code was used (*9-11*), and absorbed fractions of energy were calculated considering the trabecular marrow space, the trabecular endosteum, and the trabecular bone volume as source and target regions. An extension to consider the trabecular active marrow as a target region was also discussed. Following the same methodology, a new three-dimensional model of electron transport in cortical bone was also presented. Likewise, absorbed fractions of energy were tabulated considering the cortical Haversian canal, the cortical bone endosteum, and the cortical bone volume as source and target regions. Using these new tabulated absorbed fractions of energy in the two structures of the skeletal system, S values were subsequently calculated considering twenty-two different bone sites. For this purpose, reference masses were derived using the ICRP Publication 70 on the anatomy and physiology of the human skeletal system (*25*). A skeletal averaged S value was also given based on these twenty-two site-specific S values. Considerations of the trabecular active marrow as a source and target region were also discussed, and estimates of the radionuclide S values for this region as both source and target regions were given. Finally, a relative dosimetric advantage factor was introduced to compare radionuclides with potential for use in the alleviation of bone pain from bone metastases. Several radionuclides were compared, and the low-energy beta emitter ^{33}P was found to be the most dosimetricaly favorable for the palliation of bone pain.

The work presented here in bone dosimetry will first allow a better understanding of the dosimetry of the skeletal system. Few publications describing the physics behind the different trabecular bone models are available. The methodology used in the derivation of the skeletal S values given in MIRD Pamphlet 11 (*5*) is only described in an Oak Ridge National Laboratory Report dated from 1974 (*70*), and the dosimetric bone model used in the MIRDOSE3 computer program is partially described in a symposium paper published by K. F. Eckerman in 1985 (*74*). In this sense, the research presented here will fulfill the lack of referenced methods in the dosimetry associated with the skeletal system. Consequently, better model of activity concentration in the active marrow will be able to be developed, allowing for better estimates of dose to the active marrow, and correspondingly better prediction of myelotoxicity.

Trabecular bone chord length distributions for children aged 20 months and nine year-old were also measured by the research group of Spiers (*54, 56, 67*). Future work will therefore be to apply these new bone dosimetric models to younger ages. This will involve derivation of reference masses for trabecular bone and cortical bone as was done for the adult. Other future work will be to update the ICRP Publication 30 model of the bone (*72*). As it was seen in Chapter 3, this model is very simplistic, and consequently the specific effective energy (SEE is the ICRP equivalent for the MIRD S value) derived for the radionuclides of interest in health physics need to be updated using these new bone models. Consequently, absorbed fractions from alpha particle sources need to be calculated. Since alpha particles have very short ranges, a simplistic one-dimensional transport model is sufficient. Finally, another possible area of development for bone dosimetry is the use of more realistic characterizations of trabecular bone as suggested by Jokisch et al. using direct imaging techniques such as NMR microscopy (*84, 203*) or computed topography microscopic imaging.

In the field of therapeutic nuclear medicine dosimetry, a new dose calculation methodology using S values in a cubical geometry was developed for nonuniform activity distribution. The EGS4-PRESTA Monte Carlo transport code was used to calculate specific absorbed fractions of energy for twenty-one voxel sizes between 0.05 cm and 1.0 cm. Subsequently an interpolation schema was developed for use with a C program to generate voxel S values for any radionuclide and for any voxel size between 0.05 cm and 1.0 cm. This approach to dosimetry of nonuniform activity distribution offers an accurate and computationally efficient tool within homogeneous media.

Future work in this area will involve the development of method to acquire sequential activity SPECT images to derive cumulated activity at the voxel level, which still remains somewhat challenging.

APPENDIX A
ABSORBED FRACTIONS OF ENERGY WITHIN THE NEW HEAD AND BRAIN PEDIATRIC MODELS

This appendix gives tables of absorbed fractions of energy for the full series of head and brain models. Both electron and photon sources are given in these Tables. Absorbed fractions of energy are given for 14 source regions, and 16 target regions. Tables A.1 through A.14 are for a newborn phantom, Tables A.15 through A.28 are for 1-year-old phantom, Tables A.29 through A.42 are for 5-year-old phantom, Tables A.43 through A.56 are for 10-year-old phantom, Tables A.57 through A.70 are for 15-year-old phantom, and Tables A.71 through A.84 are for an adult phantom. In each of these Tables, absorbed fractions of energy with coefficient of variation (CV) between 30% and 50% are indicated by the character *, absorbed fractions of energy with coefficient of variation (CV) between 50% and 70% are indicated by the character †, and absorbed fractions of energy with coefficient of variation (CV) greater than 70% are indicated by the character ‡.

Absorbed Fractions of Energy in a Mathematical Model of the Head and Brain of a Newborn

Table A.1: Absorbed Fractions for the Newborn Phantom for Sources Located in the Brain (Total).

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.65E-01	8.80E-01	7.39E-01	4.38E-01	1.77E-01	9.81E-02	1.02E-01	1.07E-01	9.87E-02	8.87E-02	7.93E-02	5.72E-02
Caud. Nucl.	7.05E-03	6.87E-03	6.37E-03	3.95E-03	1.66E-03	8.80E-04	9.08E-04	9.28E-04	8.48E-04	7.55E-04	6.76E-04	5.15E-04
Cerebellum	5.42E-02	4.70E-02	3.81E-02	2.15E-02	8.63E-03	4.72E-03	5.05E-03	5.24E-03	4.91E-03	4.38E-03	3.89E-03	2.83E-03
Cereb. Cort.	4.00E-01	3.43E-01	2.77E-01	1.62E-01	6.55E-02	3.67E-02	3.83E-02	4.04E-02	3.77E-02	3.37E-02	2.99E-02	2.17E-02
Cranium	2.75E-02	6.61E-02	8.24E-02	6.51E-02	2.58E-02	8.07E-03	6.04E-03	6.22E-03	5.82E-03	5.25E-03	4.79E-03	3.58E-03
Eyes	0.00E+00	2.49E-05	2.33E-04	7.56E-04	6.03E-04	4.41E-04	4.70E-04	4.97E-04	4.50E-04	4.24E-04	3.85E-04	2.94E-04
Lent. Nucl.	1.27E-02	1.22E-02	1.06E-02	6.56E-03	2.68E-03	1.46E-03	1.52E-03	1.57E-03	1.42E-03	1.30E-03	1.16E-03	8.28E-04
Mandible	4.20E-05	7.62E-04	2.93E-03	8.24E-03	7.31E-03	2.97E-03	2.16E-03	2.09E-03	2.02E-03	1.84E-03	1.76E-03	1.39E-03
Other Tissues	5.85E-04	8.87E-03	2.36E-02	3.66E-02	2.48E-02	1.53E-02	1.55E-02	1.63E-02	1.55E-02	1.43E-02	1.32E-02	1.06E-02
Skin	4.60E-04	3.89E-03	6.89E-03	7.11E-03	3.76E-03	2.36E-03	2.61E-03	2.80E-03	2.49E-03	2.15E-03	2.03E-03	1.60E-03
Spinal Col.	1.00E-06‡	4.80E-05	1.11E-04	1.86E-04	1.39E-04	8.77E-05	8.86E-05	8.87E-05	9.16E-05	7.35E-05	6.29E-05	6.15E-05
Spinal Skel.	4.37E-05	9.95E-04	3.70E-03	8.42E-03	6.59E-03	2.50E-03	1.77E-03	1.67E-03	1.56E-03	1.41E-03	1.33E-03	1.08E-03
Thalami	1.12E-02	1.10E-02	9.96E-03	6.29E-03	2.58E-03	1.37E-03	1.43E-03	1.45E-03	1.34E-03	1.20E-03	1.10E-03	7.87E-04
Thyroid	0.00E+00	0.00E+00	5.97E-06*	3.58E-05	3.91E-05	2.63E-05	3.38E-05	2.92E-05	3.37E-05	3.05E-05	3.08E-05	2.71E-05
Trunk	0.00E+00	0.00E+00	1.01E-05*	6.50E-04	1.85E-03	1.79E-03	2.09E-03	2.73E-03	3.20E-03	3.23E-03	3.24E-03	2.84E-03
White Matter	4.65E-01	4.46E-01	3.84E-01	2.29E-01	9.24E-02	5.11E-02	5.28E-02	5.49E-02	5.06E-02	4.57E-02	4.10E-02	2.94E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.87E-01	9.67E-01	9.45E-01	9.22E-01	8.34E-01
Caud. Nucl.	7.22E-03	7.23E-03	7.23E-03	7.13E-03	7.00E-03	7.09E-03	7.13E-03	7.23E-03	7.06E-03	6.96E-03	6.99E-03	6.90E-03
Cerebellum	5.72E-02	5.74E-02	5.77E-02	5.75E-02	5.75E-02	5.77E-02	5.75E-02	5.65E-02	5.42E-02	5.23E-02	5.05E-02	4.37E-02
Cereb. Cort.	4.31E-01	4.32E-01	4.32E-01	4.31E-01	4.32E-01	4.30E-01	4.29E-01	4.20E-01	4.04E-01	3.84E-01	3.65E-01	3.11E-01
Cranium	0.00E+00	0.00E+00	1.35E-06‡	1.24E-06‡	5.45E-06*	8.66E-06	1.21E-04	6.37E-03	2.05E-02	2.73E-02	3.06E-02	3.36E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-07‡	5.58E-07*	1.10E-06*	2.33E-06	3.51E-06	6.62E-06	2.65E-04
Lent. Nucl.	1.27E-02	1.28E-02	1.26E-02	1.26E-02	1.26E-02	1.28E-02	1.25E-02	1.26E-02	1.24E-02	1.24E-02	1.24E-02	1.20E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-07‡	9.30E-07†	3.21E-06*	7.99E-06	5.81E-05	1.91E-04	3.90E-04	1.38E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-06†	2.44E-06	1.26E-05	3.78E-05	9.75E-04	4.24E-03	8.09E-03	2.16E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-06‡	3.25E-07†	3.76E-06	6.68E-06	1.36E-03	4.17E-03	6.00E-03	8.90E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.40E-07‡	3.46E-06*	2.15E-05	4.90E-05	1.09E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-06*	2.45E-06*	6.33E-06	7.03E-05	3.02E-04	6.13E-04	1.87E-03
Thalami	1.11E-02	1.12E-02	1.14E-02	1.13E-02	1.11E-02	1.11E-02	1.13E-02	1.10E-02	1.12E-02	1.11E-02	1.12E-02	1.08E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-08‡	1.08E-07†	9.86E-08†	9.34E-08†	4.37E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.63E-07†	3.21E-06	8.01E-06	1.75E-05	2.19E-05	4.55E-05
White Matter	4.66E-01	4.65E-01	4.65E-01	4.66E-01	4.66E-01	4.67E-01	4.66E-01	4.65E-01	4.64E-01	4.64E-01	4.61E-01	4.35E-01

Table A.2: Absorbed Fractions for the Newborn Phantom for Sources Located in the Caudate Nuclei.

Photon Absorbed Fraction of Energy: ϕ

Targets	Energy (MeV) 0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.86E-01	8.87E-01	5.52E-01	2.24E-01	1.23E-01	1.26E-01	1.31E-01	1.20E-01	1.08E-01	9.73E-02	7.10E-02
Caud. Nucl.	7.26E-01	3.95E-01	2.05E-01	7.06E-02	2.07E-02	1.20E-02	1.33E-02	1.41E-02	1.16E-02	8.88E-03	6.76E-03	2.97E-03
Cerebellum	0.00E+00	7.85E-05	1.43E-03	4.11E-03	3.00E-03	1.74E-03	1.71E-03	1.73E-03	1.65E-03	1.52E-03	1.41E-03	1.14E-03
Cereb. Cort.	5.53E-04	2.47E-02	7.84E-02	9.59E-02	4.94E-02	2.73E-02	2.73E-02	2.81E-02	2.59E-02	2.39E-02	2.21E-02	1.80E-02
Cranium	3.40E-05	5.80E-03	2.73E-02	4.21E-02	2.18E-02	6.99E-03	4.85E-03	4.70E-03	4.39E-03	4.01E-03	3.77E-03	3.05E-03
Eyes	0.00E+00	3.00E-05*	4.87E-04	1.59E-03	1.27E-03	7.61E-04	8.08E-04	8.54E-04	8.13E-04	6.82E-04	6.74E-04	5.66E-04
Lent. Nucl.	4.59E-02	6.98E-02	5.74E-02	2.79E-02	9.64E-03	5.18E-03	5.48E-03	5.74E-03	5.40E-03	4.88E-03	4.39E-03	2.77E-03
Mandible	0.00E+00	4.13E-04	4.20E-03	1.41E-02	1.21E-02	4.72E-03	3.24E-03	3.17E-03	2.89E-03	2.74E-03	2.56E-03	2.08E-03
Other Tissues	0.00E+00	1.92E-03	1.67E-02	4.09E-02	3.10E-02	1.86E-02	1.83E-02	1.89E-02	1.76E-02	1.62E-02	1.50E-02	1.22E-02
Skin	0.00E+00	1.22E-04	1.60E-03	4.23E-03	3.07E-03	1.98E-03	2.13E-03	2.23E-03	2.02E-03	1.81E-03	1.66E-03	1.39E-03
Spinal Col.	0.00E+00	1.00E-06‡	2.37E-05	1.14E-04	9.89E-05	6.58E-05	6.28E-05	5.34E-05	5.49E-05	4.93E-05	4.85E-05	4.10E-05
Spinal Skel.	0.00E+00	1.69E-05*	7.79E-04	4.97E-03	5.25E-03	2.04E-03	1.31E-03	1.19E-03	1.05E-03	9.46E-04	9.16E-04	7.24E-04
Thalami	8.36E-03	2.53E-02	2.74E-02	1.61E-02	5.98E-03	3.26E-03	3.33E-03	3.45E-03	3.14E-03	2.89E-03	2.67E-03	1.92E-03
Thyroid	0.00E+00	0.00E+00	2.06E-06‡	4.38E-05	5.58E-05	4.06E-05	4.21E-05	4.22E-05	4.11E-05	4.44E-05	3.75E-05	3.31E-05
Trunk	0.00E+00	0.00E+00	1.88E-05	8.37E-04	2.19E-03	1.99E-03	2.28E-03	2.90E-03	3.14E-03	3.23E-03	3.13E-03	2.83E-03
White Matter	2.15E-01	4.44E-01	4.85E-01	3.17E-01	1.28E-01	6.93E-02	7.04E-02	7.34E-02	6.78E-02	6.19E-02	5.66E-02	4.17E-02

Electron Absorbed Fraction of Energy: ϕ

Targets	Energy (MeV) 0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.96E-01	9.94E-01	9.92E-01	9.79E-01
Caud. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.92E-01	9.75E-01	9.02E-01	7.49E-01	5.91E-01	4.54E-01	2.10E-01
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.17E-07†	1.00E-06*	3.72E-06	8.01E-06	1.23E-05	1.53E-05	3.07E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	1.41E-06‡	3.72E-06*	1.26E-05	3.03E-05	7.56E-05	1.59E-04	2.42E-04	1.01E-03	2.66E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	5.53E-07‡	2.71E-06*	5.03E-06	1.01E-05	2.59E-05	4.34E-05	5.77E-05	6.90E-05	2.17E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.18E-07‡	5.33E-07‡	1.78E-06	4.63E-06	4.95E-06	7.19E-06	1.73E-05
Lent. Nucl.	1.81E-05	5.34E-05	9.84E-05	1.72E-04	4.66E-04	1.58E-03	4.90E-03	1.87E-02	4.45E-02	6.69E-02	8.27E-02	8.12E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.08E-07‡	1.37E-06†	3.66E-06	1.18E-05	2.32E-05	2.85E-05	3.80E-05	8.85E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.13E-07‡	5.70E-06	1.56E-05	4.25E-05	8.95E-05	1.41E-04	1.75E-04	6.80E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.75E-07†	1.50E-06†	4.42E-06	9.03E-06	1.63E-05	1.98E-05	3.77E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.22E-08‡	1.12E-07‡	3.78E-07†	2.87E-07	3.35E-07	1.26E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-06	4.87E-06	8.97E-06	1.21E-05	1.51E-05	2.42E-05
Thalami	0.00E+00	0.00E+00	4.60E-07‡	1.38E-06‡	5.13E-07‡	3.49E-06	6.25E-06	4.69E-04	5.10E-03	1.32E-02	2.25E-02	3.65E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.40E-09‡	3.02E-07‡	1.98E-07‡	2.40E-07*	4.65E-07*	3.53E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.21E-07‡	2.15E-07‡	4.49E-07*	3.80E-06	1.19E-05	1.66E-05	2.06E-05	4.57E-05
White Matter	8.89E-05	2.00E-04	3.74E-04	7.99E-04	1.93E-03	6.20E-03	1.97E-02	7.74E-02	1.97E-01	3.17E-01	4.16E-01	5.78E-01

Table A.3: Absorbed Fractions for the Newborn Phantom for Sources Located in the Cerebellum.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.44E-01	8.23E-01	6.59E-01	3.75E-01	1.50E-01	8.42E-02	8.81E-02	9.28E-02	8.54E-02	7.64E-02	6.88E-02	4.94E-02
Caud. Nucl.	0.00E+00	9.97E-06*	1.91E-04	5.42E-04	3.89E-04	2.40E-04	2.15E-04	2.04E-04	1.90E-04	1.96E-04	1.71E-04	1.48E-04
Cerebellum	8.82E-01	6.63E-01	4.33E-01	1.81E-01	5.82E-02	3.27E-02	3.56E-02	3.78E-02	3.36E-02	2.92E-02	2.49E-02	1.46E-02
Cereb. Cort.	6.07E-02	1.37E-01	1.59E-01	1.12E-01	4.84E-02	2.72E-02	2.83E-02	3.00E-02	2.81E-02	2.57E-02	2.39E-02	1.82E-02
Cranium	4.38E-02	9.97E-02	1.12E-01	7.70E-02	2.86E-02	8.71E-03	6.73E-03	6.81E-03	6.49E-03	5.88E-03	5.39E-03	3.86E-03
Eyes	0.00E+00	0.00E+00	2.92E-06†	6.59E-05	1.28E-04	1.05E-04	1.19E-04	1.41E-04	1.37E-04	1.22E-04	1.22E-04	1.08E-04
Lent. Nucl.	0.00E+00	3.05E-05	4.39E-04	1.15E-03	7.61E-04	4.26E-04	4.30E-04	4.57E-04	4.07E-04	3.73E-04	3.29E-04	3.09E-04
Mandible	0.00E+00	1.00E-06‡	1.62E-04	2.56E-03	3.54E-03	1.63E-03	1.15E-03	1.16E-03	1.15E-03	1.07E-03	1.02E-03	8.25E-04
Other Tissues	1.56E-03	2.01E-02	4.15E-02	4.89E-02	2.98E-02	1.81E-02	1.86E-02	2.00E-02	1.91E-02	1.76E-02	1.63E-02	1.28E-02
Skin	4.35E-04	4.62E-03	8.04E-03	7.69E-03	3.90E-03	2.35E-03	2.56E-03	2.81E-03	2.45E-03	2.22E-03	2.00E-03	1.58E-03
Spinal Col.	0.00E+00	3.71E-05	1.81E-04	3.48E-04	2.72E-04	1.76E-04	1.89E-04	1.93E-04	1.74E-04	1.65E-04	1.65E-04	1.19E-04
Spinal Skel.	1.05E-04	2.13E-03	8.59E-03	1.91E-02	1.33E-02	4.90E-03	3.52E-03	3.48E-03	3.26E-03	2.98E-03	2.73E-03	2.21E-03
Thalami	0.00E+00	6.81E-05	7.24E-04	1.60E-03	9.73E-04	5.40E-04	5.48E-04	5.19E-04	5.44E-04	4.63E-04	4.30E-04	3.24E-04
Thyroid	0.00E+00	0.00E+00	1.99E-06‡	2.08E-05	4.62E-05	2.93E-05	3.22E-05	3.49E-05	3.87E-05	2.98E-05	3.16E-05	2.91E-05
Trunk	0.00E+00	0.00E+00	5.97E-06†	4.80E-04	2.12E-03	2.39E-03	2.86E-03	3.85E-03	4.41E-03	4.43E-03	4.43E-03	4.13E-03
White Matter	5.97E-04	2.38E-02	6.45E-02	7.64E-02	4.00E-02	2.24E-02	2.23E-02	2.30E-02	2.18E-02	1.99E-02	1.85E-02	1.52E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.80E-01	9.48E-01	9.15E-01	8.81E-01	7.58E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-07‡	4.18E-07*	1.36E-06	1.92E-06	2.43E-06	3.95E-06
Cerebellum	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.90E-01	9.58E-01	8.94E-01	8.26E-01	7.61E-01	5.39E-01
Cereb. Cort.	3.13E-05	5.70E-05	8.67E-05	1.97E-04	5.04E-04	1.78E-03	5.36E-03	2.13E-02	5.41E-02	8.81E-02	1.20E-01	1.84E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	2.40E-06‡	4.89E-06	1.23E-05	1.30E-04	1.00E-02	3.36E-02	4.47E-02	4.91E-02	5.04E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E-07‡	0.00E+00	1.15E-07‡	2.34E-07*	6.11E-07*	1.18E-06*	1.69E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-08‡	0.00E+00	2.35E-07†	1.60E-06*	3.18E-06	3.61E-06	3.66E-06	7.35E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-07‡	5.99E-07‡	1.63E-06*	3.59E-06	7.02E-06	1.09E-05	1.33E-05	2.15E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E-06*	6.38E-06	1.84E-05	4.67E-05	2.66E-03	1.25E-02	2.34E-02	5.20E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.68E-07‡	1.13E-06*	1.49E-06	6.94E-06	1.09E-03	3.60E-03	5.74E-03	1.07E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-07‡	3.82E-07*	1.11E-06	1.41E-06*	2.27E-06	8.79E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-07‡	2.22E-06†	4.88E-06	1.54E-05	1.76E-04	7.43E-04	1.36E-03	4.06E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.52E-07‡	5.67E-07†	1.56E-06	3.24E-06	5.59E-06	3.83E-06	8.81E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.84E-09‡	2.70E-08‡	1.93E-08‡	2.80E-07‡	2.88E-07†	2.40E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-06*	4.67E-06	1.35E-05	1.76E-05	2.95E-05	7.25E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	5.13E-07‡	3.91E-06*	9.71E-06	2.88E-05	6.40E-05	1.32E-04	1.92E-04	6.27E-04	3.43E-02

Table A.4: Absorbed Fractions for the Newborn Phantom for Sources Located in the Cerebral Cortex.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.27E-01	7.94E-01	6.42E-01	3.75E-01	1.52E-01	8.52E-02	8.96E-02	9.44E-02	8.67E-02	7.79E-02	7.00E-02	5.01E-02
Caud. Nucl.	4.00E-06†	4.22E-04	1.32E-03	1.54E-03	8.23E-04	4.72E-04	4.20E-04	4.59E-04	4.25E-04	4.09E-04	3.61E-04	2.97E-04
Cerebellum	8.07E-03	1.81E-02	2.10E-02	1.49E-02	6.41E-03	3.63E-03	3.78E-03	3.97E-03	3.69E-03	3.44E-03	3.15E-03	2.47E-03
Cereb. Cort.	8.51E-01	6.13E-01	4.16E-01	2.03E-01	7.52E-02	4.28E-02	4.61E-02	4.89E-02	4.42E-02	3.89E-02	3.40E-02	2.28E-02
Cranium	5.70E-02	1.16E-01	1.21E-01	7.93E-02	2.88E-02	8.85E-03	6.97E-03	7.13E-03	6.65E-03	6.16E-03	5.47E-03	3.86E-03
Eyes	0.00E+00	2.39E-05	2.72E-04	7.21E-04	6.04E-04	4.37E-04	4.48E-04	4.54E-04	4.37E-04	4.26E-04	3.93E-04	3.05E-04
Lent. Nucl.	2.98E-04	1.72E-03	3.03E-03	2.94E-03	1.52E-03	8.04E-04	8.23E-04	8.29E-04	8.18E-04	6.71E-04	6.46E-04	5.30E-04
Mandible	1.04E-04	1.25E-03	3.78E-03	8.18E-03	6.85E-03	2.74E-03	1.99E-03	2.03E-03	1.91E-03	1.77E-03	1.68E-03	1.37E-03
Other Tissues	1.11E-03	1.33E-02	2.79E-02	3.60E-02	2.32E-02	1.44E-02	1.48E-02	1.57E-02	1.48E-02	1.38E-02	1.30E-02	1.02E-02
Skin	9.53E-04	6.97E-03	1.03E-02	8.69E-03	4.22E-03	2.63E-03	2.84E-03	3.13E-03	2.77E-03	2.51E-03	2.22E-03	1.68E-03
Spinal Col.	7.00E-06*	5.48E-05	1.47E-04	1.84E-04	1.27E-04	7.56E-05	9.38E-05	8.86E-05	8.40E-05	7.79E-05	7.50E-05	5.46E-05
Spinal Skel.	8.80E-05	1.51E-03	4.53E-03	8.47E-03	6.27E-03	2.43E-03	1.65E-03	1.61E-03	1.55E-03	1.39E-03	1.34E-03	1.04E-03
Thalami	2.80E-05	7.91E-04	2.18E-03	2.65E-03	1.37E-03	7.35E-04	7.49E-04	7.57E-04	6.88E-04	6.25E-04	5.72E-04	4.41E-04
Thyroid	0.00E+00	0.00E+00	4.91E-06*	2.79E-05	4.05E-05	2.88E-05	2.81E-05	2.76E-05	3.19E-05	2.66E-05	2.86E-05	2.37E-05
Trunk	0.00E+00	0.00E+00	2.01E-05	5.93E-04	1.55E-03	1.59E-03	1.89E-03	2.51E-03	2.87E-03	2.93E-03	2.87E-03	2.64E-03
White Matter	6.71E-02	1.59E-01	1.94E-01	1.46E-01	6.47E-02	3.57E-02	3.66E-02	3.84E-02	3.59E-02	3.30E-02	3.03E-02	2.29E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.75E-01	9.34E-01	8.90E-01	8.46E-01	7.20E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-07‡	8.94E-07*	1.84E-06	2.43E-06	4.03E-06	1.82E-05	4.54E-04
Cerebellum	4.32E-06*	5.94E-06*	1.22E-05	3.20E-05	5.41E-05	2.51E-04	6.92E-04	2.89E-03	7.13E-03	1.18E-02	1.59E-02	2.45E-02
Cereb. Cort.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.96E-01	9.87E-01	9.49E-01	8.68E-01	7.80E-01	6.94E-01	4.76E-01
Cranium	0.00E+00	0.00E+00	1.14E-06‡	1.88E-06‡	3.13E-06*	1.03E-05	2.49E-04	1.32E-02	4.30E-02	5.75E-02	6.35E-02	5.46E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E-08‡	7.86E-08‡	6.14E-07*	2.95E-06	3.31E-06	7.53E-06	5.02E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.59E-07‡	8.31E-07	1.05E-05	1.30E-04	4.44E-04	8.77E-04	2.79E-03
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E-06‡	1.99E-06*	7.74E-06	1.10E-04	4.38E-04	8.71E-04	2.56E-03
Other Tissues	0.00E+00	9.63E-07‡	0.00E+00	0.00E+00	1.41E-06‡	6.46E-06	1.29E-05	3.93E-05	1.82E-03	7.87E-03	1.53E-02	3.51E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.60E-07‡	6.76E-07†	2.07E-06*	7.54E-06	3.04E-03	9.20E-03	1.30E-02	1.55E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-07‡	4.19E-08‡	9.38E-06	4.31E-05	9.93E-05	2.20E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E-06*	2.23E-06*	6.15E-06	1.23E-04	5.92E-04	1.25E-03	3.24E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.21E-09‡	2.67E-07*	1.82E-06	3.38E-06	1.83E-05	9.69E-05	1.27E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E-07‡	9.41E-08†	1.85E-07*	1.06E-07*	2.90E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-06†	1.78E-06	9.80E-06	1.46E-05	1.98E-05	4.68E-05
White Matter	3.42E-05	6.88E-05	1.17E-04	2.22E-04	5.64E-04	1.89E-03	5.73E-03	2.28E-02	5.91E-02	9.75E-02	1.34E-01	2.13E-01

Table A.5: Absorbed Fractions for the Newborn Phantom for Sources Located in the Cranial CSF.

Photon Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	4.07E-01	4.22E-01	3.80E-01	2.49E-01	1.07E-01	6.16E-02	6.50E-02	6.94E-02	6.43E-02	5.89E-02	5.33E-02	3.96E-02
Caud. Nucl.	2.00E-06‡	2.20E-04	7.28E-04	1.14E-03	6.15E-04	3.63E-04	3.56E-04	3.48E-04	3.62E-04	3.17E-04	3.03E-04	2.25E-04
Cerebellum	3.84E-02	3.72E-02	3.04E-02	1.74E-02	6.88E-03	3.89E-03	4.15E-03	4.56E-03	4.20E-03	3.85E-03	3.49E-03	2.49E-03
Cereb. Cort.	3.65E-01	3.33E-01	2.52E-01	1.35E-01	5.32E-02	3.08E-02	3.30E-02	3.56E-02	3.28E-02	2.97E-02	2.65E-02	1.84E-02
Cranium	4.13E-01	3.58E-01	2.65E-01	1.32E-01	4.24E-02	1.28E-02	1.06E-02	1.09E-02	9.78E-03	7.98E-03	6.67E-03	4.14E-03
Eyes	0.00E+00	4.49E-05	2.91E-04	7.67E-04	6.56E-04	4.17E-04	4.52E-04	5.05E-04	4.48E-04	4.47E-04	3.86E-04	3.31E-04
Lent. Nucl.	5.50E-05	9.33E-04	2.04E-03	2.24E-03	1.24E-03	6.52E-04	6.64E-04	7.03E-04	6.05E-04	6.13E-04	5.52E-04	4.46E-04
Mandible	3.08E-04	2.27E-03	5.35E-03	9.69E-03	7.39E-03	2.90E-03	2.21E-03	2.29E-03	2.11E-03	1.96E-03	1.81E-03	1.45E-03
Other Tissues	5.40E-03	2.96E-02	4.47E-02	4.54E-02	2.64E-02	1.65E-02	1.72E-02	1.86E-02	1.76E-02	1.62E-02	1.50E-02	1.13E-02
Skin	4.66E-03	1.50E-02	1.64E-02	1.16E-02	5.12E-03	3.24E-03	3.65E-03	3.89E-03	3.50E-03	3.01E-03	2.60E-03	1.73E-03
Spinal Col.	3.40E-05	1.49E-04	2.00E-04	2.38E-04	1.58E-04	1.01E-04	1.05E-04	1.07E-04	9.88E-05	9.84E-05	8.48E-05	6.68E-05
Spinal Skel.	4.25E-04	3.33E-03	6.99E-03	1.09E-02	7.42E-03	2.63E-03	1.94E-03	1.95E-03	1.81E-03	1.68E-03	1.52E-03	1.18E-03
Thalami	5.00E-06†	4.73E-04	1.34E-03	1.85E-03	1.02E-03	5.91E-04	5.70E-04	5.80E-04	5.34E-04	4.92E-04	4.89E-04	4.01E-04
Thyroid	0.00E+00	0.00E+00	9.97E-06*	3.76E-05	3.22E-05	3.13E-05	2.82E-05	3.50E-05	3.07E-05	3.57E-05	3.35E-05	2.22E-05
Trunk	0.00E+00	0.00E+00	2.18E-05	5.83E-04	1.61E-03	1.57E-03	1.84E-03	2.51E-03	2.72E-03	2.79E-03	2.71E-03	2.57E-03
White Matter	3.64E-03	5.02E-02	9.26E-02	8.92E-02	4.33E-02	2.46E-02	2.55E-02	2.69E-02	2.51E-02	2.34E-02	2.15E-02	1.73E-02

Electron Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.16E-03	2.31E-03	3.97E-03	8.11E-03	2.03E-02	6.72E-02	2.04E-01	3.88E-01	4.40E-01	4.51E-01	4.51E-01	4.33E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.45E-07†	9.06E-07	2.00E-06	2.29E-06	3.52E-06	1.99E-04
Cerebellum	1.08E-04	2.10E-04	3.51E-04	7.21E-04	1.92E-03	6.26E-03	1.95E-02	3.72E-02	4.20E-02	4.22E-02	4.15E-02	3.71E-02
Cereb. Cort.	1.05E-03	2.10E-03	3.62E-03	7.38E-03	1.84E-02	6.09E-02	1.85E-01	3.51E-01	3.98E-01	4.08E-01	4.00E-01	3.05E-01
Cranium	1.08E-03	2.30E-03	3.88E-03	8.09E-03	1.99E-02	6.70E-02	2.03E-01	3.85E-01	3.43E-01	2.52E-01	1.99E-01	1.15E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.84E-07‡	5.40E-07*	2.08E-06	3.82E-06	2.71E-05	9.35E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.86E-08‡	6.76E-07*	2.04E-06	4.59E-06	5.37E-06	8.19E-05	1.51E-03
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.37E-07‡	1.29E-06†	2.49E-06	1.98E-05	1.07E-03	2.16E-03	3.06E-03	4.58E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	8.04E-07‡	1.73E-06†	5.43E-06	1.46E-05	8.42E-05	2.87E-02	5.37E-02	6.43E-02	7.23E-02
Skin	0.00E+00	0.00E+00	0.00E+00	7.18E-07‡	3.48E-07‡	3.19E-06	5.07E-06	1.39E-05	4.23E-02	4.57E-02	4.05E-02	2.79E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-07‡	3.38E-07†	1.26E-04	2.69E-04	3.45E-04	4.10E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-06†	2.53E-06*	7.85E-06	2.03E-03	4.13E-03	5.27E-03	6.62E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-07‡	4.59E-08‡	1.76E-06	2.93E-06	5.56E-06	5.45E-06	5.34E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-08‡	9.61E-08‡	4.07E-07†	1.69E-07†	7.16E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.69E-08‡	4.07E-06	8.67E-06	1.60E-05	1.82E-05	4.10E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	4.56E-07‡	2.49E-06*	1.25E-05	2.89E-05	8.41E-05	1.55E-04	9.88E-04	9.34E-03	8.84E-02

Table A.6: Absorbed Fractions for the Newborn Phantom for Sources Located in the Cranium.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E-01	2.27E-01	2.74E-01	2.13E-01	9.76E-02	5.68E-02	5.99E-02	6.40E-02	6.03E-02	5.54E-02	5.07E-02	3.80E-02
Caud. Nucl.	2.00E-06‡	1.58E-04	6.27E-04	1.05E-03	5.84E-04	3.31E-04	3.25E-04	3.42E-04	3.26E-04	2.96E-04	2.92E-04	2.26E-04
Cerebellum	9.41E-03	1.97E-02	2.11E-02	1.47E-02	6.23E-03	3.59E-03	3.83E-03	4.07E-03	3.82E-03	3.57E-03	3.14E-03	2.37E-03
Cereb. Cort.	8.95E-02	1.73E-01	1.73E-01	1.12E-01	4.72E-02	2.76E-02	2.98E-02	3.21E-02	3.04E-02	2.76E-02	2.52E-02	1.77E-02
Cranium	7.50E-01	4.78E-01	3.11E-01	1.47E-01	4.63E-02	1.42E-02	1.20E-02	1.22E-02	1.01E-02	8.13E-03	6.80E-03	4.11E-03
Eyes	0.00E+00	4.40E-05	3.04E-04	7.55E-04	6.46E-04	4.42E-04	4.57E-04	5.02E-04	5.02E-04	4.40E-04	4.29E-04	3.12E-04
Lent. Nucl.	1.99E-05	6.68E-04	1.74E-03	2.10E-03	1.13E-03	6.43E-04	6.48E-04	6.77E-04	6.29E-04	5.66E-04	5.27E-04	4.26E-04
Mandible	1.38E-03	3.84E-03	6.56E-03	1.02E-02	7.45E-03	2.85E-03	2.21E-03	2.29E-03	2.12E-03	1.96E-03	1.87E-03	1.44E-03
Other Tissues	3.21E-02	5.29E-02	5.67E-02	4.80E-02	2.73E-02	1.68E-02	1.77E-02	1.90E-02	1.80E-02	1.65E-02	1.51E-02	1.15E-02
Skin	3.45E-02	3.21E-02	2.35E-02	1.33E-02	5.66E-03	3.57E-03	3.95E-03	4.35E-03	3.83E-03	3.10E-03	2.65E-03	1.74E-03
Spinal Col.	1.42E-04	2.37E-04	2.49E-04	2.47E-04	1.44E-04	9.01E-05	1.00E-04	1.03E-04	1.07E-04	9.19E-05	9.18E-05	7.13E-05
Spinal Skel.	2.66E-03	6.12E-03	9.29E-03	1.16E-02	7.48E-03	2.71E-03	2.02E-03	1.98E-03	1.91E-03	1.71E-03	1.54E-03	1.18E-03
Thalami	1.00E-06‡	3.04E-04	1.12E-03	1.67E-03	9.36E-04	5.41E-04	5.38E-04	5.53E-04	5.16E-04	4.74E-04	4.35E-04	3.74E-04
Thyroid	0.00E+00	0.00E+00	5.88E-06†	2.68E-05	3.03E-05	2.43E-05	3.18E-05	3.49E-05	2.80E-05	3.44E-05	3.11E-05	2.75E-05
Trunk	0.00E+00	0.00E+00	3.47E-05	6.11E-04	1.58E-03	1.56E-03	1.85E-03	2.47E-03	2.73E-03	2.77E-03	2.69E-03	2.51E-03
White Matter	1.45E-03	3.34E-02	7.55E-02	7.99E-02	4.04E-02	2.34E-02	2.42E-02	2.56E-02	2.40E-02	2.23E-02	2.06E-02	1.64E-02

Electron Absorbed Fraction of Energy: ϕ												
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	2.53E-07‡	6.76E-07‡	6.95E-06	1.29E-05	4.54E-05	1.17E-03	6.63E-02	2.15E-01	2.90E-01	3.25E-01	3.59E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E-07‡	7.64E-07†	8.24E-07	2.54E-06	2.73E-06	3.43E-06	1.68E-04
Cerebellum	0.00E+00	2.53E-07‡	0.00E+00	2.95E-07‡	1.02E-06‡	2.12E-06*	7.07E-05	6.07E-03	2.00E-02	2.69E-02	2.98E-02	3.07E-02
Cereb. Cort.	0.00E+00	0.00E+00	6.76E-07‡	4.44E-06	8.76E-06	2.72E-05	1.07E-03	6.01E-02	1.95E-01	2.62E-01	2.90E-01	2.53E-01
Cranium	1.00E+00	9.99E-01	9.99E-01	9.98E-01	9.94E-01	9.80E-01	9.38E-01	7.55E-01	4.56E-01	3.15E-01	2.42E-01	1.34E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.95E-09‡	1.86E-07†	7.19E-07†	2.20E-06	3.39E-06	5.78E-05	1.04E-03
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.32E-07‡	5.05E-07‡	8.59E-07*	2.04E-06	3.57E-06	6.25E-06	4.40E-05	1.27E-03
Mandible	1.52E-06‡	2.24E-06†	3.33E-06†	6.10E-06*	2.61E-05	8.09E-05	2.62E-04	1.02E-03	2.36E-03	3.31E-03	4.03E-03	5.34E-03
Other Tissues	5.53E-05	1.24E-04	1.80E-04	3.39E-04	9.19E-04	3.03E-03	9.24E-03	3.53E-02	7.19E-02	8.28E-02	8.64E-02	8.34E-02
Skin	9.72E-05	2.00E-04	3.32E-04	6.66E-04	1.67E-03	5.70E-03	1.82E-02	6.79E-02	8.50E-02	6.63E-02	5.43E-02	3.40E-02
Spinal Col.	6.90E-07‡	8.90E-07‡	1.31E-06‡	1.66E-06‡	4.79E-06†	1.44E-05	3.53E-05	1.69E-04	3.36E-04	4.35E-04	4.51E-04	4.91E-04
Spinal Skel.	2.38E-06†	7.33E-06*	1.13E-05*	2.01E-05	5.82E-05	2.14E-04	6.16E-04	2.38E-03	5.36E-03	6.70E-03	7.14E-03	7.80E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-08‡	2.90E-07†	1.50E-06	3.35E-06	5.20E-06	5.73E-06	3.94E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.47E-07‡	0.00E+00	4.04E-08‡	8.44E-08‡	5.58E-07†	1.00E-07†	1.06E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.60E-07‡	5.12E-07†	5.31E-06	1.05E-05	1.33E-05	1.73E-05	3.74E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	2.21E-06†	2.24E-06*	1.48E-05	2.88E-05	7.90E-05	1.55E-04	5.58E-04	4.73E-03	7.42E-02

Table A.7: Absorbed Fractions for the Newborn Phantom for Sources Located in the Lateral Ventricles.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.97E-01	9.32E-01	6.03E-01	2.47E-01	1.34E-01	1.37E-01	1.42E-01	1.30E-01	1.17E-01	1.06E-01	7.75E-02
Caud. Nucl.	2.50E-03	1.39E-02	1.67E-02	1.02E-02	3.73E-03	1.98E-03	2.13E-03	2.15E-03	2.07E-03	1.85E-03	1.69E-03	1.27E-03
Cerebellum	0.00E+00	8.42E-04	5.26E-03	9.33E-03	5.33E-03	2.93E-03	2.89E-03	2.92E-03	2.71E-03	2.51E-03	2.41E-03	1.90E-03
Cereb. Cort.	6.99E-03	5.30E-02	1.10E-01	1.19E-01	5.91E-02	3.25E-02	3.20E-02	3.29E-02	3.07E-02	2.81E-02	2.59E-02	2.06E-02
Cranium	0.00E+00	1.34E-03	1.64E-02	3.67E-02	2.07E-02	6.53E-03	4.56E-03	4.40E-03	4.14E-03	3.81E-03	3.48E-03	2.83E-03
Eyes	0.00E+00	1.00E-06‡	1.15E-04	6.78E-04	7.08E-04	4.51E-04	4.81E-04	5.05E-04	4.48E-04	4.21E-04	3.96E-04	3.01E-04
Lent. Nucl.	1.08E-03	9.58E-03	1.58E-02	1.18E-02	4.88E-03	2.59E-03	2.62E-03	2.62E-03	2.40E-03	2.27E-03	2.09E-03	1.64E-03
Mandible	0.00E+00	4.48E-05	1.39E-03	8.33E-03	8.38E-03	3.40E-03	2.37E-03	2.24E-03	2.10E-03	2.00E-03	1.83E-03	1.49E-03
Other Tissues	0.00E+00	5.01E-04	9.45E-03	3.26E-02	2.65E-02	1.63E-02	1.58E-02	1.65E-02	1.54E-02	1.45E-02	1.33E-02	1.08E-02
Skin	0.00E+00	6.63E-05	1.30E-03	4.13E-03	3.10E-03	1.92E-03	2.04E-03	2.18E-03	1.98E-03	1.80E-03	1.62E-03	1.34E-03
Spinal Col.	0.00E+00	3.00E-06†	4.31E-05	1.54E-04	1.33E-04	9.53E-05	9.54E-05	9.27E-05	7.44E-05	7.52E-05	6.97E-05	5.90E-05
Spinal Skel.	0.00E+00	2.40E-05	1.26E-03	6.96E-03	6.67E-03	2.65E-03	1.77E-03	1.61E-03	1.54E-03	1.38E-03	1.27E-03	1.05E-03
Thalami	4.29E-03	2.00E-02	2.61E-02	1.65E-02	6.28E-03	3.32E-03	3.45E-03	3.53E-03	3.33E-03	2.98E-03	2.82E-03	2.07E-03
Thyroid	0.00E+00	0.00E+00	4.97E-06*	4.78E-05	5.77E-05	4.00E-05	3.48E-05	3.11E-05	3.50E-05	3.68E-05	2.78E-05	1.78E-05
Trunk	0.00E+00	0.00E+00	1.01E-05*	7.59E-04	2.18E-03	2.20E-03	2.54E-03	3.50E-03	3.87E-03	4.08E-03	4.07E-03	3.71E-03
White Matter	2.03E-01	4.12E-01	4.78E-01	3.31E-01	1.36E-01	7.27E-02	7.37E-02	7.64E-02	7.07E-02	6.46E-02	5.91E-02	4.40E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.96E-01	9.94E-01	9.93E-01	9.85E-01
Caud. Nucl.	0.00E+00	0.00E+00	6.14E-07‡	0.00E+00	3.34E-08‡	1.43E-06†	3.44E-06	9.05E-06	1.53E-04	2.96E-03	8.59E-03	2.38E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E-06‡	9.55E-07‡	2.18E-06*	7.36E-06	1.69E-05	2.04E-05	3.10E-05	7.19E-05
Cereb. Cort.	0.00E+00	0.00E+00	1.17E-06‡	1.08E-06‡	3.39E-06*	1.91E-05	3.83E-05	9.60E-05	1.78E-03	9.85E-03	2.25E-02	7.92E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-06‡	2.96E-06	9.87E-06	2.17E-05	3.96E-05	5.41E-05	6.37E-05	1.03E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E-07‡	8.87E-07*	2.42E-06	3.24E-06	4.22E-06	8.92E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	7.96E-07‡	4.40E-07‡	1.76E-06*	3.34E-06	9.62E-06	1.86E-04	1.39E-03	3.27E-03	1.55E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-06†	2.63E-06*	6.69E-06	1.58E-05	2.02E-05	2.67E-05	4.67E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.39E-07‡	4.54E-06	1.05E-05	3.60E-05	7.89E-05	1.18E-04	1.55E-04	2.88E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.72E-07‡	5.15E-07‡	8.53E-07*	4.47E-06	8.79E-06	1.53E-05	2.02E-05	3.73E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-08‡	3.67E-07*	4.12E-07†	5.29E-07	6.17E-07*	1.11E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.84E-07†	1.82E-06*	6.15E-06	1.11E-05	1.80E-05	1.92E-05	3.31E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	5.71E-07‡	1.35E-06†	2.46E-06*	1.19E-05	3.15E-04	2.27E-03	6.18E-03	1.11E-02	3.33E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-08‡	1.37E-07*	9.15E-08‡	3.46E-07†	5.64E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.54E-08‡	9.08E-07†	4.71E-06	1.03E-05	1.80E-05	2.59E-05	5.99E-05
White Matter	1.19E-04	2.06E-04	3.83E-04	7.46E-04	1.84E-03	6.07E-03	1.91E-02	7.61E-02	1.92E-01	2.97E-01	3.78E-01	5.13E-01

Table A.8: Absorbed Fractions for the Newborn Phantom for Sources Located in the Lentiform Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.68E-01	8.48E-01	5.21E-01	2.14E-01	1.17E-01	1.20E-01	1.24E-01	1.14E-01	1.02E-01	9.25E-02	6.67E-02
Caud. Nucl.	2.56E-02	3.95E-02	3.23E-02	1.56E-02	5.37E-03	2.93E-03	3.13E-03	3.23E-03	3.11E-03	2.75E-03	2.47E-03	1.53E-03
Cerebellum	0.00E+00	1.05E-04	1.84E-03	5.15E-03	3.52E-03	2.05E-03	1.98E-03	2.01E-03	1.85E-03	1.77E-03	1.61E-03	1.36E-03
Cereb. Cort.	1.05E-02	6.00E-02	1.05E-01	1.02E-01	5.11E-02	2.81E-02	2.82E-02	2.90E-02	2.70E-02	2.46E-02	2.30E-02	1.81E-02
Cranium	3.72E-04	1.44E-02	3.96E-02	4.88E-02	2.35E-02	7.55E-03	5.20E-03	5.10E-03	4.75E-03	4.39E-03	4.03E-03	3.24E-03
Eyes	0.00E+00	6.01E-06†	1.94E-04	1.14E-03	1.08E-03	7.26E-04	7.13E-04	7.25E-04	6.74E-04	5.86E-04	5.64E-04	4.64E-04
Lent. Nucl.	7.77E-01	4.76E-01	2.65E-01	9.68E-02	2.94E-02	1.67E-02	1.84E-02	1.95E-02	1.66E-02	1.35E-02	1.07E-02	5.14E-03
Mandible	0.00E+00	1.40E-03	9.97E-03	2.45E-02	1.75E-02	6.40E-03	4.56E-03	4.33E-03	3.97E-03	3.63E-03	3.42E-03	2.74E-03
Other Tissues	6.62E-05	1.03E-02	4.50E-02	7.44E-02	4.77E-02	2.77E-02	2.70E-02	2.76E-02	2.59E-02	2.40E-02	2.20E-02	1.78E-02
Skin	0.00E+00	6.01E-05	1.17E-03	3.70E-03	2.98E-03	1.96E-03	2.07E-03	2.18E-03	2.05E-03	1.78E-03	1.66E-03	1.34E-03
Spinal Col.	0.00E+00	2.04E-06‡	5.61E-05	1.89E-04	1.54E-04	8.90E-05	8.51E-05	8.41E-05	7.10E-05	6.75E-05	5.53E-05	5.44E-05
Spinal Skel.	0.00E+00	1.02E-04	2.04E-03	9.13E-03	8.16E-03	3.00E-03	1.96E-03	1.72E-03	1.57E-03	1.42E-03	1.30E-03	1.03E-03
Thalami	4.92E-02	8.01E-02	6.67E-02	3.23E-02	1.07E-02	5.98E-03	6.24E-03	6.60E-03	6.17E-03	5.43E-03	4.94E-03	3.16E-03
Thyroid	0.00E+00	0.00E+00	1.22E-05*	9.64E-05	7.41E-05	5.23E-05	5.78E-05	5.08E-05	6.13E-05	4.89E-05	5.20E-05	4.25E-05
Trunk	0.00E+00	0.00E+00	6.02E-05	1.59E-03	3.24E-03	2.91E-03	3.29E-03	4.11E-03	4.52E-03	4.54E-03	4.42E-03	3.99E-03
White Matter	1.36E-01	3.01E-01	3.58E-01	2.55E-01	1.08E-01	5.83E-02	5.88E-02	6.08E-02	5.68E-02	5.13E-02	4.72E-02	3.54E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.96E-01	9.94E-01	9.92E-01	9.54E-01
Caud. Nucl.	1.02E-05*	2.94E-05	4.37E-05	9.85E-05	2.55E-04	8.77E-04	2.76E-03	1.07E-02	2.52E-02	3.77E-02	4.67E-02	4.57E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.49E-07‡	1.44E-06*	5.55E-06	9.80E-06	1.50E-05	2.00E-05	3.44E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	4.34E-07‡	2.56E-06*	1.18E-05	3.27E-05	4.07E-04	4.72E-03	1.47E-02	3.01E-02	9.43E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	7.96E-07‡	2.13E-06†	5.55E-06	1.32E-05	3.04E-05	5.08E-05	6.31E-05	3.61E-04	9.44E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.10E-08‡	6.53E-07*	1.14E-06*	4.15E-06	4.72E-06	6.98E-06	1.24E-05
Lent. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.79E-01	9.16E-01	7.93E-01	6.72E-01	5.65E-01	2.97E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E-07‡	3.30E-06*	5.60E-06	1.81E-05	3.23E-05	4.32E-05	5.71E-05	7.27E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	7.24E-07‡	3.37E-06*	9.49E-06	2.53E-05	7.13E-05	1.39E-04	2.15E-04	3.05E-04	1.63E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.84E-08‡	7.89E-07‡	1.49E-06*	4.53E-06	1.05E-05	1.50E-05	1.94E-05	3.54E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.20E-11‡	4.83E-07†	5.46E-07†	6.55E-07†	4.76E-07*	1.48E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-06†	3.34E-06*	7.74E-06	1.39E-05	1.91E-05	2.11E-05	3.82E-05
Thalami	2.99E-05	4.75E-05	1.03E-04	2.22E-04	4.71E-04	1.72E-03	5.08E-03	1.98E-02	4.70E-02	7.20E-02	9.06E-02	9.47E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.36E-08‡	2.84E-07‡	3.19E-07*	3.55E-07*	1.42E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-07‡	8.34E-07*	4.62E-06	1.54E-05	2.43E-05	3.39E-05	7.03E-05
White Matter	8.36E-05	1.54E-04	2.50E-04	5.41E-04	1.26E-03	4.22E-03	1.31E-02	5.18E-02	1.26E-01	1.96E-01	2.56E-01	4.02E-01

Table A.9: Absorbed Fractions for the Newborn Phantom for Sources Located in the Spinal CSF.

Photon Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	4.72E-04	7.58E-03	2.08E-02	4.01E-02	3.35E-02	2.18E-02	2.19E-02	2.30E-02	2.19E-02	2.03E-02	1.90E-02	1.54E-02
Caud. Nucl.	0.00E+00	1.00E-06‡	3.35E-05	1.97E-04	2.12E-04	1.51E-04	1.35E-04	1.42E-04	1.33E-04	1.29E-04	1.04E-04	9.65E-05
Cerebellum	0.00E+00	3.25E-04	1.94E-03	4.32E-03	3.37E-03	2.13E-03	2.17E-03	2.27E-03	2.13E-03	2.02E-03	1.93E-03	1.47E-03
Cereb. Cort.	4.62E-04	5.64E-03	1.15E-02	1.76E-02	1.36E-02	8.90E-03	9.01E-03	9.64E-03	9.18E-03	8.60E-03	7.92E-03	6.36E-03
Cranium	7.34E-03	1.26E-02	1.39E-02	1.55E-02	9.55E-03	3.50E-03	2.61E-03	2.59E-03	2.47E-03	2.20E-03	2.09E-03	1.59E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	6.45E-05	1.43E-04	1.29E-04	1.54E-04	1.70E-04	1.62E-04	1.44E-04	1.49E-04	1.17E-04
Lent. Nucl.	0.00E+00	7.99E-06*	1.19E-04	5.91E-04	5.92E-04	3.70E-04	3.68E-04	3.66E-04	3.52E-04	3.10E-04	2.98E-04	2.60E-04
Mandible	0.00E+00	0.00E+00	4.51E-04	6.16E-03	7.54E-03	3.19E-03	2.23E-03	2.24E-03	2.14E-03	1.96E-03	1.84E-03	1.45E-03
Other Tissues	0.00E+00	2.85E-03	3.64E-02	9.82E-02	7.02E-02	4.39E-02	4.49E-02	4.69E-02	4.43E-02	4.10E-02	3.81E-02	3.08E-02
Skin	0.00E+00	8.59E-05	1.12E-03	3.57E-03	2.82E-03	1.92E-03	2.08E-03	2.27E-03	2.03E-03	1.80E-03	1.67E-03	1.33E-03
Spinal Col.	1.04E-01	1.08E-01	6.91E-02	2.67E-02	8.49E-03	4.77E-03	5.29E-03	5.65E-03	5.21E-03	4.59E-03	3.85E-03	1.92E-03
Spinal Skel.	2.23E-01	4.82E-01	5.97E-01	4.34E-01	1.60E-01	4.92E-02	3.89E-02	3.91E-02	3.68E-02	3.32E-02	3.01E-02	2.07E-02
Thalami	0.00E+00	1.80E-05	2.60E-04	7.63E-04	6.76E-04	4.21E-04	4.08E-04	4.15E-04	3.84E-04	3.69E-04	3.32E-04	3.03E-04
Thyroid	0.00E+00	1.40E-05	2.73E-04	7.01E-04	4.95E-04	2.81E-04	2.96E-04	3.04E-04	2.88E-04	2.61E-04	2.63E-04	1.87E-04
Trunk	7.68E-03	2.04E-02	3.53E-02	5.68E-02	4.73E-02	3.23E-02	3.35E-02	3.72E-02	3.63E-02	3.47E-02	3.27E-02	2.69E-02
White Matter	1.00E-05	1.57E-03	6.82E-03	1.62E-02	1.45E-02	9.48E-03	9.51E-03	9.82E-03	9.41E-03	8.62E-03	8.12E-03	6.63E-03

Electron Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.67E-07‡	4.99E-06*	1.65E-05	5.12E-05	8.29E-04	3.84E-03	7.85E-03	2.39E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E-07*	8.45E-07	5.78E-07	9.22E-07	4.26E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.77E-07‡	1.20E-06†	2.33E-06*	4.83E-06	1.24E-05	2.28E-05	7.83E-05	1.33E-03
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.00E-08‡	2.25E-06†	6.70E-06	2.14E-05	7.67E-04	3.74E-03	7.66E-03	1.91E-02
Cranium	2.86E-06†	1.19E-05	1.60E-05	3.23E-05	7.91E-05	2.31E-04	7.17E-04	2.90E-03	6.45E-03	7.88E-03	8.67E-03	9.05E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.73E-09‡	3.86E-07†	7.67E-07	1.21E-06*	1.19E-06	3.34E-06*
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-07‡	1.98E-07‡	6.31E-07*	1.25E-06	3.32E-06	5.12E-06	6.77E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E-06*	1.82E-06	7.38E-06	1.49E-05	2.30E-05	2.47E-05	5.11E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	5.43E-07‡	1.38E-06‡	1.28E-05	3.43E-05	1.08E-04	2.32E-04	3.54E-04	4.74E-04	7.01E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-08‡	5.94E-07‡	1.47E-06*	3.54E-06*	9.26E-06	1.46E-05	2.36E-05	9.57E-04
Spinal Col.	7.30E-05	1.44E-04	2.14E-04	4.67E-04	1.10E-03	3.76E-03	1.14E-02	4.62E-02	1.17E-01	1.60E-01	1.62E-01	8.64E-02
Spinal Skel.	1.16E-04	2.31E-04	3.85E-04	8.18E-04	2.04E-03	6.59E-03	2.04E-02	8.16E-02	2.10E-01	3.19E-01	3.96E-01	5.19E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E-07†	1.01E-06*	2.00E-06	3.07E-06	5.00E-06	7.67E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.11E-07‡	5.48E-07†	7.64E-07*	1.21E-06	1.78E-06	2.88E-06	6.16E-06
Trunk	7.76E-06*	6.90E-06*	1.16E-05	2.74E-05	6.69E-05	2.41E-04	7.73E-04	2.84E-03	7.49E-03	1.26E-02	1.75E-02	3.68E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-06*	6.95E-06	2.26E-05	4.41E-05	6.98E-05	9.64E-05	3.45E-03

Table A.10: Absorbed Fractions for the Newborn Phantom for Sources Located in the Spinal Skeleton.

Photon Absorbed Fraction of Energy: ϕ

Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
	Energy (MeV)											
Brain (Total)	1.87E-04	3.71E-03	1.37E-02	3.44E-02	3.16E-02	2.13E-02	2.16E-02	2.29E-02	2.15E-02	2.02E-02	1.87E-02	1.52E-02
Caud. Nucl.	0.00E+00	1.95E-06‡	2.77E-05	1.77E-04	2.24E-04	1.47E-04	1.33E-04	1.35E-04	1.41E-04	1.37E-04	1.13E-04	9.26E-05
Cerebellum	2.20E-05	4.44E-04	1.68E-03	4.04E-03	3.32E-03	2.18E-03	2.26E-03	2.31E-03	2.22E-03	2.05E-03	1.92E-03	1.56E-03
Cereb. Cort.	1.62E-04	2.54E-03	7.35E-03	1.48E-02	1.27E-02	8.64E-03	8.91E-03	9.53E-03	8.91E-03	8.43E-03	7.76E-03	6.29E-03
Cranium	2.72E-03	6.69E-03	1.02E-02	1.42E-02	9.39E-03	3.52E-03	2.53E-03	2.55E-03	2.41E-03	2.24E-03	2.04E-03	1.60E-03
Eyes	0.00E+00	0.00E+00	2.19E-09‡	5.84E-05	1.39E-04	1.36E-04	1.49E-04	1.54E-04	1.61E-04	1.43E-04	1.39E-04	1.06E-04
Lent. Nucl.	0.00E+00	8.91E-06	1.31E-04	5.84E-04	5.58E-04	3.63E-04	3.56E-04	3.76E-04	3.54E-04	3.28E-04	3.11E-04	2.35E-04
Mandible	0.00E+00	2.50E-05	8.91E-04	6.59E-03	7.71E-03	3.18E-03	2.30E-03	2.24E-03	2.11E-03	1.95E-03	1.85E-03	1.49E-03
Other Tissues	2.44E-02	6.61E-02	1.07E-01	1.26E-01	7.68E-02	4.78E-02	4.95E-02	5.24E-02	4.95E-02	4.53E-02	4.18E-02	3.29E-02
Skin	9.60E-05	1.24E-03	2.95E-03	4.16E-03	2.87E-03	2.01E-03	2.21E-03	2.39E-03	2.12E-03	1.92E-03	1.73E-03	1.38E-03
Spinal Col.	1.06E-03	6.12E-03	9.07E-03	6.68E-03	2.95E-03	1.69E-03	1.80E-03	1.92E-03	1.80E-03	1.68E-03	1.60E-03	1.11E-03
Spinal Skel.	9.57E-01	8.71E-01	7.44E-01	4.62E-01	1.69E-01	5.32E-02	4.30E-02	4.37E-02	3.91E-02	3.42E-02	2.95E-02	1.88E-02
Thalami	0.00E+00	1.60E-05	2.02E-04	7.00E-04	6.98E-04	4.29E-04	4.27E-04	4.36E-04	3.94E-04	3.74E-04	3.25E-04	2.62E-04
Thyroid	1.98E-06‡	1.31E-04	4.97E-04	7.63E-04	4.49E-04	2.76E-04	2.97E-04	3.27E-04	2.70E-04	2.66E-04	2.55E-04	2.01E-04
Trunk	2.82E-03	1.02E-02	2.36E-02	4.69E-02	4.28E-02	3.01E-02	3.18E-02	3.54E-02	3.47E-02	3.28E-02	3.09E-02	2.59E-02
White Matter	3.00E-06†	6.94E-04	4.24E-03	1.37E-02	1.36E-02	9.24E-03	9.22E-03	9.83E-03	9.12E-03	8.59E-03	7.96E-03	6.50E-03

Electron Absorbed Fraction of Energy: ϕ

Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
	Energy (MeV)											
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	3.99E-08‡	2.21E-06†	5.66E-06	1.42E-05	6.09E-05	7.38E-04	3.45E-03	7.16E-03	2.26E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-07‡	1.29E-06*	1.32E-06*	1.76E-06	3.38E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	3.99E-08‡	0.00E+00	1.36E-07*	2.25E-06*	6.58E-06	1.12E-04	4.57E-04	8.90E-04	2.77E-03
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.36E-07‡	2.46E-06†	6.09E-06	2.67E-05	5.65E-04	2.90E-03	6.15E-03	1.69E-02
Cranium	1.84E-06‡	1.22E-05	1.45E-05	1.67E-05	6.21E-05	2.13E-04	6.80E-04	2.57E-03	5.67E-03	7.18E-03	7.94E-03	8.92E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-07*	4.45E-07*	2.39E-06*	2.18E-06*	2.52E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.24E-08‡	1.42E-06*	2.46E-06	3.92E-06	3.80E-06	7.88E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-07‡	2.35E-06	1.00E-05	1.63E-05	2.36E-05	3.28E-05	4.85E-05
Other Tissues	4.50E-05	6.76E-05	9.62E-05	2.08E-04	5.55E-04	1.84E-03	5.67E-03	2.21E-02	5.69E-02	9.49E-02	1.32E-01	2.37E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.22E-07‡	0.00E+00	1.75E-06†	5.50E-06	1.41E-05	2.03E-04	9.62E-04	4.68E-03
Spinal Col.	0.00E+00	0.00E+00	7.52E-07‡	4.53E-07‡	4.04E-07‡	1.06E-06*	4.26E-06	9.01E-06	1.17E-04	3.55E-03	1.03E-02	2.62E-02
Spinal Skel.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.89E-01	9.59E-01	8.94E-01	8.24E-01	7.54E-01	5.37E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E-08‡	7.25E-07†	9.00E-07*	2.57E-06	4.80E-06	4.72E-06	8.29E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.78E-08‡	3.15E-07†	3.96E-07†	1.23E-06	2.54E-06	3.65E-06	3.75E-04
Trunk	1.53E-06‡	4.70E-06*	1.02E-05	2.57E-05	5.72E-05	2.07E-04	6.38E-04	2.55E-03	6.48E-03	1.11E-02	1.58E-02	3.38E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-06‡	2.99E-06	5.08E-06	2.43E-05	5.26E-05	7.89E-05	1.12E-04	2.87E-03

Table A.11: Absorbed Fractions for the Newborn Phantom for Sources Located in the Thalami.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.83E-01	8.83E-01	5.55E-01	2.28E-01	1.25E-01	1.27E-01	1.31E-01	1.21E-01	1.08E-01	9.81E-02	7.13E-02
Caud. Nucl.	5.23E-03	1.60E-02	1.75E-02	1.02E-02	3.75E-03	2.07E-03	2.11E-03	2.17E-03	2.01E-03	1.86E-03	1.71E-03	1.23E-03
Cerebellum	0.00E+00	3.08E-04	3.93E-03	8.12E-03	4.88E-03	2.78E-03	2.71E-03	2.79E-03	2.62E-03	2.36E-03	2.22E-03	1.82E-03
Cereb. Cort.	1.39E-03	3.28E-02	8.36E-02	9.80E-02	5.10E-02	2.81E-02	2.77E-02	2.84E-02	2.65E-02	2.41E-02	2.24E-02	1.81E-02
Cranium	5.29E-05	7.72E-03	3.04E-02	4.48E-02	2.30E-02	7.35E-03	4.98E-03	4.78E-03	4.45E-03	4.18E-03	3.89E-03	3.11E-03
Eyes	0.00E+00	2.00E-06‡	6.31E-05	7.39E-04	7.88E-04	5.49E-04	5.47E-04	5.60E-04	5.18E-04	4.82E-04	4.74E-04	3.77E-04
Lent. Nucl.	5.53E-02	8.91E-02	7.54E-02	3.60E-02	1.23E-02	6.72E-03	7.03E-03	7.44E-03	7.17E-03	6.30E-03	5.54E-03	3.53E-03
Mandible	0.00E+00	3.35E-04	5.15E-03	1.82E-02	1.49E-02	5.46E-03	3.72E-03	3.57E-03	3.43E-03	3.10E-03	2.82E-03	2.28E-03
Other Tissues	7.00E-06†	6.20E-03	3.82E-02	7.29E-02	4.79E-02	2.77E-02	2.69E-02	2.76E-02	2.58E-02	2.38E-02	2.21E-02	1.79E-02
Skin	0.00E+00	2.47E-05	8.74E-04	3.59E-03	3.00E-03	1.87E-03	1.98E-03	2.10E-03	1.93E-03	1.75E-03	1.61E-03	1.29E-03
Spinal Col.	0.00E+00	1.29E-05*	1.30E-04	3.27E-04	2.17E-04	1.42E-04	1.34E-04	1.32E-04	1.15E-04	1.08E-04	9.72E-05	7.89E-05
Spinal Skel.	0.00E+00	2.86E-04	4.05E-03	1.40E-02	1.11E-02	4.04E-03	2.65E-03	2.36E-03	2.12E-03	1.99E-03	1.74E-03	1.42E-03
Thalami	8.06E-01	5.13E-01	2.91E-01	1.07E-01	3.26E-02	1.85E-02	2.03E-02	2.16E-02	1.85E-02	1.51E-02	1.22E-02	5.97E-03
Thyroid	0.00E+00	0.00E+00	1.30E-05*	1.07E-04	9.44E-05	5.45E-05	5.33E-05	6.66E-05	6.15E-05	5.67E-05	5.48E-05	4.61E-05
Trunk	0.00E+00	1.00E-06‡	7.64E-05	1.83E-03	3.80E-03	3.49E-03	3.76E-03	4.87E-03	5.40E-03	5.38E-03	5.37E-03	4.74E-03
White Matter	1.21E-01	2.93E-01	3.69E-01	2.70E-01	1.15E-01	6.17E-02	6.20E-02	6.37E-02	5.92E-02	5.40E-02	5.00E-02	3.78E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.96E-01	9.94E-01	9.92E-01	9.76E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	2.26E-07‡	4.82E-07‡	1.37E-06*	3.09E-06	3.10E-04	3.21E-03	8.56E-03	1.44E-02	2.34E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-06‡	3.08E-07‡	3.11E-06	8.28E-06	1.52E-05	2.10E-05	2.68E-05	4.96E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	2.48E-06‡	1.93E-06*	1.22E-05	3.06E-05	8.00E-05	1.59E-04	6.04E-04	3.55E-03	4.85E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	7.27E-07‡	4.83E-07‡	3.96E-06*	1.04E-05	2.65E-05	4.59E-05	6.05E-05	7.60E-05	3.42E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.88E-07‡	3.72E-07†	1.17E-06*	3.59E-06	4.14E-06	4.08E-06	1.05E-05
Lent. Nucl.	2.65E-05	5.52E-05	1.24E-04	2.30E-04	5.62E-04	1.87E-03	5.74E-03	2.23E-02	5.32E-02	8.10E-02	1.02E-01	1.07E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-06*	5.10E-06	1.41E-05	2.59E-05	3.73E-05	4.64E-05	6.86E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.73E-06*	9.59E-06	2.38E-05	7.15E-05	1.44E-04	2.11E-04	2.70E-04	4.11E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-07‡	1.18E-06*	3.86E-06	9.46E-06	1.38E-05	1.72E-05	3.34E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E-09‡	1.56E-07†	5.61E-07*	7.22E-07	2.03E-06*	2.05E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	7.02E-07‡	9.95E-07‡	1.06E-06†	3.73E-06	1.02E-05	1.84E-05	2.93E-05	2.98E-05	5.22E-05
Thalami	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.83E-01	9.33E-01	8.26E-01	7.13E-01	6.07E-01	3.36E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E-07‡	1.84E-07*	1.80E-07*	6.71E-07*	1.87E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.07E-07‡	2.66E-06*	7.23E-06	1.65E-05	2.88E-05	3.66E-05	8.55E-05
White Matter	5.04E-05	1.29E-04	2.01E-04	4.10E-04	1.05E-03	3.35E-03	1.05E-02	4.23E-02	1.07E-01	1.71E-01	2.34E-01	4.04E-01

Table A.12: Absorbed Fractions for the Newborn Phantom for Sources Located in the Third Ventricle.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.88E-01	8.98E-01	5.70E-01	2.35E-01	1.28E-01	1.31E-01	1.35E-01	1.24E-01	1.12E-01	1.01E-01	7.33E-02
Caud. Nucl.	6.51E-05	5.32E-03	1.05E-02	7.85E-03	3.16E-03	1.65E-03	1.70E-03	1.69E-03	1.60E-03	1.48E-03	1.36E-03	1.10E-03
Cerebellum	0.00E+00	3.45E-04	4.01E-03	8.53E-03	5.21E-03	2.91E-03	2.79E-03	2.87E-03	2.64E-03	2.39E-03	2.23E-03	1.82E-03
Cereb. Cort.	5.36E-04	2.46E-02	7.62E-02	9.70E-02	5.10E-02	2.80E-02	2.76E-02	2.81E-02	2.63E-02	2.40E-02	2.23E-02	1.81E-02
Cranium	1.80E-05*	5.49E-03	2.58E-02	4.22E-02	2.24E-02	7.25E-03	4.84E-03	4.65E-03	4.45E-03	4.11E-03	3.77E-03	3.01E-03
Eyes	0.00E+00	1.00E-06‡	8.84E-05	7.01E-04	8.00E-04	5.64E-04	5.43E-04	5.36E-04	5.33E-04	4.66E-04	4.42E-04	3.81E-04
Lent. Nucl.	9.05E-04	2.23E-02	3.42E-02	2.23E-02	8.26E-03	4.39E-03	4.53E-03	4.69E-03	4.35E-03	3.95E-03	3.66E-03	2.95E-03
Mandible	0.00E+00	1.73E-04	4.00E-03	1.66E-02	1.39E-02	5.24E-03	3.65E-03	3.28E-03	3.12E-03	2.89E-03	2.71E-03	2.16E-03
Other Tissues	4.00E-06*	4.34E-03	3.24E-02	6.76E-02	4.52E-02	2.67E-02	2.57E-02	2.64E-02	2.46E-02	2.27E-02	2.08E-02	1.71E-02
Skin	0.00E+00	1.51E-05*	7.74E-04	3.41E-03	2.85E-03	1.90E-03	1.94E-03	2.10E-03	1.91E-03	1.73E-03	1.58E-03	1.28E-03
Spinal Col.	0.00E+00	9.04E-06*	1.14E-04	3.10E-04	2.15E-04	1.42E-04	1.35E-04	1.30E-04	1.26E-04	1.14E-04	9.90E-05	8.63E-05
Spinal Skel.	0.00E+00	2.55E-04	4.07E-03	1.39E-02	1.10E-02	4.03E-03	2.64E-03	2.37E-03	2.16E-03	1.94E-03	1.81E-03	1.48E-03
Thalami	8.44E-02	1.92E-01	1.53E-01	6.73E-02	2.17E-02	1.19E-02	1.27E-02	1.36E-02	1.26E-02	1.18E-02	1.04E-02	5.96E-03
Thyroid	0.00E+00	0.00E+00	1.19E-05*	1.04E-04	9.82E-05	5.74E-05	5.11E-05	5.36E-05	5.30E-05	6.29E-05	4.70E-05	4.71E-05
Trunk	0.00E+00	0.00E+00	4.18E-05	1.69E-03	3.74E-03	3.39E-03	3.74E-03	4.78E-03	5.40E-03	5.38E-03	5.34E-03	4.88E-03
White Matter	4.11E-01	4.88E-01	4.71E-01	3.08E-01	1.27E-01	6.84E-02	6.97E-02	7.20E-02	6.64E-02	6.01E-02	5.41E-02	3.93E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.96E-01	9.94E-01	9.92E-01	9.81E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.60E-07†	1.36E-06	5.08E-06	1.27E-05	1.55E-05	2.08E-05	1.02E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	4.96E-08‡	0.00E+00	8.92E-07†	2.04E-06*	8.11E-06	1.48E-05	2.31E-05	2.71E-05	5.53E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	1.37E-06‡	3.46E-06*	1.39E-05	2.98E-05	7.78E-05	1.60E-04	2.55E-04	9.36E-04	3.02E-02
Cranium	0.00E+00	0.00E+00	7.02E-07‡	0.00E+00	2.12E-06†	3.34E-06*	1.16E-05	2.50E-05	4.36E-05	5.57E-05	7.16E-05	1.61E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.85E-07‡	5.14E-07†	1.17E-06*	2.84E-06*	4.19E-06	4.01E-06	9.73E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.22E-07‡	3.10E-06*	6.94E-06	1.66E-05	3.03E-05	9.45E-05	1.45E-03	5.11E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.05E-07‡	9.36E-07†	6.37E-06	1.14E-05	2.34E-05	3.40E-05	4.39E-05	7.20E-05
Other Tissues	0.00E+00	0.00E+00	7.94E-07‡	0.00E+00	3.97E-06*	7.65E-06	2.21E-05	6.89E-05	1.34E-04	1.95E-04	2.55E-04	1.94E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.37E-07‡	2.19E-08‡	7.92E-07†	5.78E-06	8.56E-06	1.60E-05	1.76E-05	3.40E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.34E-07‡	3.94E-08‡	1.20E-07‡	4.16E-07*	6.92E-07	1.93E-06*	1.16E-06	2.66E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.95E-07‡	2.21E-06†	4.25E-06	9.48E-06	1.80E-05	2.59E-05	3.22E-05	5.40E-05
Thalami	0.00E+00	0.00E+00	1.48E-06‡	9.65E-07‡	7.97E-06	1.48E-05	2.86E-05	2.65E-04	4.49E-02	1.62E-01	2.47E-01	2.38E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.62E-09‡	2.27E-07‡	2.41E-07*	3.14E-07*	1.85E-07*	4.54E-07*	1.15E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.37E-07‡	3.11E-06*	7.63E-06	1.61E-05	2.95E-05	3.79E-05	7.96E-05
White Matter	3.38E-04	6.69E-04	1.19E-03	2.50E-03	6.18E-03	2.05E-02	6.43E-02	2.48E-01	4.98E-01	5.28E-01	5.08E-01	4.85E-01

Table A.13: Absorbed Fractions for the Newborn Phantom for Sources Located in the Thyroid.

	Photon Absorbed Fraction of Energy: ϕ										
	Energy (MeV)										
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	1.80E-05	1.37E-03	1.11E-02	1.28E-02	9.14E-03	9.47E-03	1.06E-02	1.04E-02	9.77E-03	9.16E-03	7.58E-03
Caud. Nucl.	0.00E+00	0.00E+00	1.70E-05	1.06E-04	1.24E-04	7.90E-05	8.42E-05	9.86E-05	8.73E-05	7.77E-05	8.85E-05	6.83E-05
Cerebellum	0.00E+00	0.00E+00	1.09E-05*	3.52E-04	6.38E-04	5.15E-04	5.63E-04	6.34E-04	6.00E-04	5.98E-04	5.18E-04	4.25E-04
Cereb. Cort.	0.00E+00	7.98E-06*	6.33E-04	4.33E-03	4.97E-03	3.60E-03	3.78E-03	4.27E-03	4.14E-03	3.98E-03	3.73E-03	3.06E-03
Cranium	0.00E+00	1.79E-05*	6.71E-04	3.32E-03	3.25E-03	1.34E-03	9.55E-04	1.00E-03	9.62E-04	9.39E-04	8.56E-04	7.06E-04
Eyes	0.00E+00	0.00E+00	3.00E-06†	8.37E-05	1.41E-04	1.15E-04	1.19E-04	1.29E-04	1.27E-04	1.24E-04	1.23E-04	1.02E-04
Lent. Nucl.	0.00E+00	1.00E-06‡	4.78E-05	3.63E-04	3.72E-04	2.38E-04	2.24E-04	2.30E-04	2.35E-04	2.13E-04	1.94E-04	1.55E-04
Mandible	0.00E+00	2.31E-04	3.20E-03	1.04E-02	7.53E-03	2.74E-03	1.83E-03	1.72E-03	1.51E-03	1.40E-03	1.30E-03	1.10E-03
Other Tissues	2.94E-01	4.80E-01	4.40E-01	2.51E-01	9.96E-02	5.64E-02	5.92E-02	6.32E-02	5.95E-02	5.39E-02	4.90E-02	3.50E-02
Skin	4.74E-04	6.52E-03	8.56E-03	5.94E-03	2.75E-03	1.69E-03	1.85E-03	1.94E-03	1.80E-03	1.56E-03	1.44E-03	1.14E-03
Spinal Col.	0.00E+00	1.51E-05	4.18E-04	9.95E-04	6.85E-04	3.82E-04	4.29E-04	4.33E-04	4.09E-04	3.76E-04	3.23E-04	2.90E-04
Spinal Skel.	8.59E-05	1.08E-02	4.06E-02	6.40E-02	3.48E-02	1.16E-02	8.47E-03	8.35E-03	7.77E-03	7.14E-03	6.61E-03	5.38E-03
Thalami	0.00E+00	0.00E+00	4.94E-05	3.67E-04	3.38E-04	2.04E-04	2.02E-04	2.00E-04	2.03E-04	1.88E-04	1.73E-04	1.36E-04
Thyroid	6.87E-01	3.71E-01	1.94E-01	6.58E-02	1.93E-02	1.11E-02	1.24E-02	1.30E-02	1.07E-02	8.18E-03	6.33E-03	2.75E-03
Trunk	1.65E-02	7.79E-02	1.45E-01	1.75E-01	1.05E-01	6.30E-02	6.43E-02	6.88E-02	6.59E-02	6.14E-02	5.76E-02	4.66E-02
White Matter	0.00E+00	8.97E-06	5.93E-04	5.33E-03	6.15E-03	4.36E-03	4.47E-03	4.96E-03	4.94E-03	4.55E-03	4.30E-03	3.60E-03

	Electron Absorbed Fraction of Energy: ϕ										
	Energy (MeV)										
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E-06‡	1.33E-06†	2.57E-06	1.88E-05	4.22E-05	6.81E-05	8.83E-05	1.72E-04
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E-07†	5.37E-07*	5.66E-07†	8.82E-07	1.36E-06*
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.92E-09‡	2.49E-07‡	6.62E-07*	2.88E-06	4.32E-06	5.23E-06	1.13E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.60E-07†	9.62E-07†	7.21E-06	1.74E-05	2.81E-05	3.55E-05	6.84E-05
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.30E-07‡	8.76E-07*	2.85E-06	6.65E-06	8.99E-06	9.19E-06	1.92E-05
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.42E-07*	3.98E-07†	1.20E-06*	9.72E-07*	2.92E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.63E-08‡	4.45E-07*	6.36E-07*	1.13E-06*	1.68E-06	2.67E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-06†	2.93E-06	7.95E-06	1.27E-05	1.81E-05	2.06E-05	3.79E-05
Other Tissues	1.60E-04	3.48E-04	5.94E-04	1.21E-03	3.03E-03	1.03E-02	3.12E-02	1.19E-01	2.85E-01	4.32E-01	5.33E-01	5.65E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-07‡	1.75E-06†	6.40E-06	1.09E-05	1.67E-05	8.64E-04	1.25E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.86E-08‡	3.55E-07†	8.38E-07*	1.58E-06	3.68E-06	4.19E-06	7.47E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	1.20E-08‡	1.52E-06†	6.84E-06*	1.46E-05	3.71E-05	7.19E-05	9.79E-05	1.15E-04	9.34E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.98E-09‡	3.07E-07†	7.60E-07*	1.42E-06	2.57E-06	2.99E-06
Thyroid	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.97E-01	9.90E-01	9.68E-01	8.76E-01	6.99E-01	5.36E-01	4.14E-01	2.07E-01
Trunk	0.00E+00	3.65E-07‡	1.92E-06†	2.96E-06†	1.50E-05	7.80E-05	3.84E-04	2.78E-03	1.15E-02	2.45E-02	4.12E-02	1.11E-01
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E-06‡	1.06E-06†	1.25E-06*	9.70E-06	1.93E-05	3.18E-05	4.17E-05	8.22E-05

Table A.14: Absorbed Fractions for the Newborn Phantom for Sources Located in the White Matter.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.99E-01	9.57E-01	8.24E-01	4.94E-01	1.98E-01	1.10E-01	1.13E-01	1.18E-01	1.09E-01	9.77E-02	8.79E-02	6.34E-02
Caud. Nucl.	3.33E-03	6.79E-03	7.39E-03	4.78E-03	1.92E-03	1.00E-03	1.07E-03	1.12E-03	1.00E-03	9.77E-04	8.75E-04	6.03E-04
Cerebellum	6.00E-05	2.83E-03	7.75E-03	9.48E-03	4.89E-03	2.76E-03	2.75E-03	2.89E-03	2.71E-03	2.46E-03	2.22E-03	1.87E-03
Cereb. Cort.	6.23E-02	1.47E-01	1.80E-01	1.35E-01	5.91E-02	3.31E-02	3.38E-02	3.57E-02	3.33E-02	3.04E-02	2.81E-02	2.15E-02
Cranium	8.90E-04	2.08E-02	4.78E-02	5.14E-02	2.32E-02	7.26E-03	5.27E-03	5.19E-03	5.00E-03	4.54E-03	4.21E-03	3.39E-03
Eyes	0.00E+00	2.00E-05	2.32E-04	8.42E-04	7.30E-04	4.94E-04	4.98E-04	5.50E-04	5.30E-04	4.73E-04	4.18E-04	3.41E-04
Lent. Nucl.	3.72E-03	8.11E-03	9.76E-03	6.72E-03	2.94E-03	1.61E-03	1.61E-03	1.61E-03	1.56E-03	1.38E-03	1.28E-03	9.93E-04
Mandible	7.99E-06	3.93E-04	2.36E-03	8.43E-03	7.88E-03	3.15E-03	2.18E-03	2.22E-03	2.10E-03	1.88E-03	1.78E-03	1.51E-03
Other Tissues	2.89E-05	3.56E-03	1.70E-02	3.33E-02	2.44E-02	1.50E-02	1.48E-02	1.58E-02	1.47E-02	1.36E-02	1.27E-02	1.04E-02
Skin	1.70E-05*	1.38E-03	4.39E-03	5.98E-03	3.60E-03	2.22E-03	2.39E-03	2.53E-03	2.23E-03	2.00E-03	1.86E-03	1.51E-03
Spinal Col.	0.00E+00	1.20E-05*	7.91E-05	1.59E-04	1.25E-04	8.03E-05	8.29E-05	8.04E-05	7.48E-05	6.69E-05	7.29E-05	5.13E-05
Spinal Skel.	3.00E-06†	3.49E-04	2.29E-03	6.89E-03	6.04E-03	2.28E-03	1.56E-03	1.47E-03	1.40E-03	1.24E-03	1.15E-03	9.64E-04
Thalami	2.82E-03	6.92E-03	8.71E-03	6.46E-03	2.76E-03	1.45E-03	1.45E-03	1.47E-03	1.42E-03	1.29E-03	1.19E-03	9.00E-04
Thyroid	0.00E+00	0.00E+00	9.63E-07‡	3.97E-05	3.42E-05	2.40E-05	2.83E-05	3.34E-05	3.76E-05	3.19E-05	2.66E-05	2.39E-05
Trunk	0.00E+00	0.00E+00	9.82E-06*	6.62E-04	1.76E-03	1.72E-03	2.11E-03	2.82E-03	3.14E-03	3.17E-03	3.25E-03	2.94E-03
White Matter	9.20E-01	7.73E-01	5.95E-01	3.21E-01	1.22E-01	6.74E-02	7.02E-02	7.33E-02	6.65E-02	5.91E-02	5.25E-02	3.62E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.96E-01	9.94E-01	9.91E-01	9.34E-01
Caud. Nucl.	3.05E-06*	1.51E-06‡	3.26E-06†	1.17E-05	3.14E-05	8.42E-05	2.85E-04	1.13E-03	3.03E-03	4.78E-03	6.34E-03	8.77E-03
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.51E-07‡	3.95E-07‡	3.51E-06	7.55E-06	1.53E-05	2.42E-05	7.66E-05	4.19E-03
Cereb. Cort.	3.18E-05	6.31E-05	1.09E-04	1.95E-04	5.06E-04	1.69E-03	5.38E-03	2.13E-02	5.48E-02	9.07E-02	1.25E-01	1.97E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	9.21E-07‡	2.41E-06*	6.67E-06*	1.27E-05	2.91E-05	5.03E-05	1.27E-04	9.63E-04	1.51E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.53E-08‡	1.79E-08‡	1.05E-06*	3.31E-06	4.92E-06*	4.66E-06	9.77E-05
Lent. Nucl.	0.00E+00	5.16E-06*	3.12E-06*	1.52E-05*	3.57E-05	1.02E-04	3.59E-04	1.36E-03	3.43E-03	5.34E-03	6.85E-03	1.07E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.26E-07‡	3.08E-06	8.93E-06	1.54E-05	2.00E-05	3.12E-05	5.17E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-07‡	6.35E-06	1.19E-05	3.86E-05	7.56E-05	1.15E-04	1.87E-04	7.13E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.70E-07‡	1.69E-06*	6.01E-06	1.30E-05	1.72E-05	2.65E-05	3.46E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.34E-07‡	0.00E+00	2.83E-08‡	4.87E-07	4.42E-07*	5.96E-07	3.33E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.35E-07‡	7.74E-08‡	1.56E-06*	5.89E-06	1.06E-05	1.49E-05	1.77E-05	5.25E-04
Thalami	7.18E-07‡	8.11E-07‡	6.60E-06*	7.28E-06	2.24E-05	9.22E-05	2.58E-04	9.90E-04	2.60E-03	4.12E-03	5.64E-03	9.47E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-09‡	0.00E+00	6.98E-08‡	2.02E-07*	9.53E-08‡	1.43E-07*	6.08E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-08‡	1.76E-06*	3.33E-06*	1.06E-05	1.75E-05	2.18E-05	4.65E-05
White Matter	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.71E-01	9.26E-01	8.80E-01	8.35E-01	6.88E-01

Absorbed Fractions of Energy in a Mathematical Model of the Head and Brain of a One-Year-Old

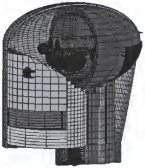


Table A.15: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Brain (Total).

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.71E-01	9.01E-01	7.83E-01	5.04E-01	2.28E-01	1.31E-01	1.33E-01	1.38E-01	1.27E-01	1.14E-01	1.04E-01	7.67E-02
Caud. Nucl.	7.39E-03	7.26E-03	6.98E-03	4.85E-03	2.20E-03	1.25E-03	1.25E-03	1.28E-03	1.19E-03	1.06E-03	9.65E-04	6.85E-04
Cerebellum	9.58E-02	8.69E-02	7.39E-02	4.62E-02	2.05E-02	1.20E-02	1.22E-02	1.26E-02	1.15E-02	1.05E-02	9.50E-03	6.88E-03
Cereb. Cort.	3.97E-01	3.48E-01	2.90E-01	1.82E-01	8.21E-02	4.81E-02	4.93E-02	5.13E-02	4.71E-02	4.26E-02	3.87E-02	2.86E-02
Cranium	2.29E-02	7.39E-02	1.11E-01	1.08E-01	5.10E-02	1.59E-02	1.08E-02	1.03E-02	9.76E-03	8.91E-03	8.13E-03	6.30E-03
Eyes	0.00E+00	3.99E-06†	4.11E-05	3.36E-04	3.65E-04	3.32E-04	3.36E-04	3.75E-04	3.54E-04	3.20E-04	2.86E-04	2.23E-04
Lent. Nucl.	1.37E-02	1.33E-02	1.22E-02	8.48E-03	3.96E-03	2.23E-03	2.23E-03	2.24E-03	2.03E-03	1.83E-03	1.68E-03	1.23E-03
Mandible	2.00E-06‡	3.12E-04	1.84E-03	8.36E-03	1.18E-02	6.17E-03	4.03E-03	3.67E-03	3.48E-03	3.38E-03	3.10E-03	2.57E-03
Other Tissues	7.04E-05	3.93E-03	1.65E-02	3.70E-02	3.33E-02	2.36E-02	2.34E-02	2.46E-02	2.33E-02	2.17E-02	2.02E-02	1.64E-02
Skin	3.73E-05	1.42E-03	3.93E-03	5.61E-03	3.68E-03	2.54E-03	2.78E-03	3.04E-03	2.75E-03	2.41E-03	2.23E-03	1.80E-03
Spinal Col.	1.00E-06‡	1.90E-05*	5.82E-05	1.54E-04	1.49E-04	1.09E-04	1.06E-04	1.08E-04	1.11E-04	9.07E-05	1.05E-04	7.89E-05
Spinal Skel.	2.98E-06†	3.32E-04	1.98E-03	7.77E-03	9.33E-03	4.42E-03	2.71E-03	2.43E-03	2.25E-03	2.10E-03	1.91E-03	1.55E-03
Thalami	1.11E-02	1.10E-02	1.04E-02	7.20E-03	3.50E-03	1.93E-03	1.97E-03	1.96E-03	1.72E-03	1.68E-03	1.49E-03	1.10E-03
Thyroid	0.00E+00	0.00E+00	9.97E-07‡	7.56E-06*	1.92E-05	1.52E-05	1.49E-05	1.80E-05	2.33E-05	1.90E-05	1.90E-05	1.41E-05
Trunk	0.00E+00	0.00E+00	2.98E-06†	1.99E-04	1.06E-03	1.48E-03	1.77E-03	2.61E-03	3.19E-03	3.46E-03	3.48E-03	3.42E-03
White Matter	4.30E-01	4.19E-01	3.74E-01	2.45E-01	1.10E-01	6.30E-02	6.37E-02	6.60E-02	6.04E-02	5.41E-02	4.92E-02	3.66E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.90E-01	9.74E-01	9.56E-01	9.38E-01	8.67E-01
Caud. Nucl.	7.25E-03	7.42E-03	7.27E-03	7.50E-03	7.44E-03	7.31E-03	7.31E-03	7.40E-03	7.47E-03	7.27E-03	7.21E-03	7.23E-03
Cerebellum	9.87E-02	1.00E-01	9.95E-02	9.96E-02	9.97E-02	9.99E-02	9.94E-02	9.86E-02	9.61E-02	9.39E-02	9.16E-02	8.30E-02
Cereb. Cort.	4.23E-01	4.23E-01	4.23E-01	4.22E-01	4.22E-01	4.22E-01	4.20E-01	4.14E-01	4.00E-01	3.86E-01	3.72E-01	3.25E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	1.50E-06†	4.64E-06*	1.06E-05	3.26E-05	3.63E-03	1.63E-02	2.73E-02	3.37E-02	4.23E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.11E-09‡	5.09E-07*	7.11E-07	3.03E-06*	2.32E-06	5.73E-05
Lent. Nucl.	1.35E-02	1.36E-02	1.33E-02	1.36E-02	1.35E-02	1.35E-02	1.35E-02	1.33E-02	1.35E-02	1.34E-02	1.34E-02	1.32E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.94E-07‡	5.11E-06	1.22E-05	3.23E-05	8.45E-05	2.09E-04	9.39E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	4.91E-07‡	1.27E-06‡	4.93E-06*	1.45E-05	5.23E-05	1.55E-04	1.46E-03	4.15E-03	1.66E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.25E-07†	1.19E-06	6.61E-06	4.65E-05	1.38E-03	2.95E-03	6.17E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E-07†	4.27E-07*	4.96E-06*	1.61E-05	6.38E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.40E-07‡	2.79E-06*	7.96E-06	1.91E-05	9.09E-05	2.56E-04	1.16E-03
Thalami	1.13E-02	1.11E-02	1.13E-02	1.13E-02	1.12E-02	1.13E-02	1.11E-02	1.12E-02	1.10E-02	1.11E-02	1.11E-02	1.10E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.43E-08‡	8.28E-08‡	4.59E-07†	1.53E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.08E-06	8.70E-06	1.30E-05	1.86E-05	4.76E-05
White Matter	4.31E-01	4.30E-01	4.31E-01	4.31E-01	4.31E-01	4.31E-01	4.31E-01	4.30E-01	4 30E-01	4.29E-01	4.27E-01	4.14E-01

Table A.16: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Caudate Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.96E-01	9.39E-01	6.53E-01	3.00E-01	1.70E-01	1.69E-01	1.73E-01	1.58E-01	1.43E-01	1.29E-01	9.76E-02
Caud. Nucl.	7.79E-01	4.62E-01	2.52E-01	9.04E-02	2.81E-02	1.64E-02	1.81E-02	1.91E-02	1.62E-02	1.31E-02	1.04E-02	4.86E-03
Cerebellum	0.00E+00	9.18E-05	2.22E-03	8.55E-03	7.55E-03	4.64E-03	4.30E-03	4.35E-03	4.06E-03	3.81E-03	3.52E-03	2.90E-03
Cereb. Cort.	3.10E-05	1.07E-02	5.81E-02	1.00E-01	6.36E-02	3.72E-02	3.57E-02	3.58E-02	3.30E-02	3.04E-02	2.81E-02	2.30E-02
Cranium	5.00E-06*	2.59E-03	2.50E-02	6.27E-02	4.20E-02	1.41E-02	8.61E-03	7.71E-03	7.08E-03	6.66E-03	6.24E-03	4.99E-03
Eyes	0.00E+00	0.00E+00	4.33E-05	4.44E-04	6.07E-04	4.80E-04	5.02E-04	5.02E-04	4.62E-04	4.38E-04	4.12E-04	3.37E-04
Lent. Nucl.	4.84E-02	8.68E-02	7.73E-02	4.07E-02	1.48E-02	8.32E-03	8.55E-03	8.87E-03	8.38E-03	7.63E-03	6.81E-03	4.63E-03
Mandible	0.00E+00	4.67E-05	1.67E-03	1.13E-02	1.64E-02	8.62E-03	5.42E-03	4.79E-03	4.45E-03	4.10E-03	3.92E-03	3.23E-03
Other Tissues	0.00E+00	2.40E-04	6.59E-03	3.11E-02	3.52E-02	2.57E-02	2.48E-02	2.52E-02	2.37E-02	2.17E-02	2.03E-02	1.65E-02
Skin	0.00E+00	3.28E-05	6.77E-04	2.88E-03	2.88E-03	2.13E-03	2.28E-03	2.40E-03	2.18E-03	2.01E-03	1.80E-03	1.51E-03
Spinal Col.	0.00E+00	0.00E+00	6.02E-06*	5.56E-05	1.08E-04	7.94E-05	7.97E-05	6.21E-05	6.96E-05	6.69E-05	4.56E-05	4.55E-05
Spinal Skel.	0.00E+00	0.00E+00	2.52E-04	3.61E-03	6.92E-03	3.58E-03	2.09E-03	1.67E-03	1.50E-03	1.35E-03	1.24E-03	1.01E-03
Thalami	6.67E-03	2.36E-02	2.84E-02	1.91E-02	8.15E-03	4.43E-03	4.49E-03	4.56E-03	4.15E-03	3.77E-03	3.54E-03	2.64E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	9.80E-06*	2.10E-05	1.75E-05	1.73E-05	1.56E-05	2.40E-05	1.88E-05	1.97E-05	1.48E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	2.48E-04	1.23E-03	1.64E-03	1.89E-03	2.67E-03	3.22E-03	3.34E-03	3.48E-03	3.28E-03
White Matter	1.61E-01	3.82E-01	4.81E-01	3.66E-01	1.66E-01	9.26E-02	9.18E-02	9.35E-02	8.61E-02	7.88E-02	7.20E-02	5.58E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.85E-01
Caud. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.82E-01	9.27E-01	8.12E-01	6.90E-01	5.75E-01	2.88E-01
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.15E-08‡	2.48E-06*	3 40E-06	1.10E-05	2.10E-05	3.17E-05	3.91E-05	6.80E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.53E-07‡	4.00E-06†	1.14E-05	2.62E-05	8.83E-05	1.86E-04	2.74E-04	3.50E-04	3.99E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	1.44E-06‡	2.16E-06*	6.02E-06	1.58E-05	4.28E-05	7.11E-05	9.12E-05	1.12E-04	2.16E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E-07‡	1.03E-06*	2.85E-06*	3.35E-06	4.11E-06	8.40E-06
Lent. Nucl.	2.26E-05	5.08E-05	8.12E-05	1.96E-04	3.95E-04	1.43E-03	4.37E-03	1.73E-02	4.27E-02	6.69E-02	8.77E-02	1.12E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.73E-07‡	5.99E-06	1.72E-05	3.01E-05	4.25E-05	5.83E-05	9.52E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.97E-07‡	3.53E-06	1.42E-05	4.69E-05	1.10E-04	1.74E-04	2.29E-04	4.26E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.67E-07‡	1.48E-06*	5.25E-06	8.49E-06	1.65E-05	1.99E-05	3.85E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.83E-08‡	7.08E-08‡	1.08E-07‡	4.18E-07*	6.12E-07*	5.04E-07*	1.02E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-07‡	2.86E-06	6.97E-06	1.01E-05	1.59E-05	2.08E-05	3.48E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	6.40E-07‡	1.90E-06*	1.73E-06	1.82E-05	5.45E-04	3.58E-03	9.21E-03	1.59E-02	3.57E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.90E-08‡	8.49E-08‡	7.09E-08†	4.27E-08†	8.59E-08‡	2.50E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.58E-09‡	1.49E-06†	3.74E-06	8.54E-06	1.41E-05	1.95E-05	4.74E-05
White Matter	7.47E-05	1.35E-04	2.40E-04	5.37E-04	1.30E-03	4.40E-03	1.35E-02	5.38E-02	1.38E-01	2.23E-01	2.99E-01	4.94E-01

Table A.17: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Cerebellum.

	Photon Absorbed Fraction of Energy: φ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.62E-01	8.74E-01	7.38E-01	4.62E-01	2.06E-01	1.19E-01	1.23E-01	1.27E-01	1.17E-01	1.05E-01	9.53E-02	7.02E-02
Caud. Nucl.	0.00E+00	4.99E-06†	1.66E-04	6.46E-04	5.95E-04	3.52E-04	3.31E-04	3.29E-04	2.91E-04	2.76E-04	2.81E-04	2.09E-04
Cerebellum	9.20E-01	7.56E-01	5.49E-01	2.64E-01	9.40E-02	5.36E-02	5.73E-02	6.00E-02	5.44E-02	4.75E-02	4.23E-02	2.77E-02
Cereb. Cort.	4.17E-02	1.06E-01	1.42E-01	1.21E-01	6.10E-02	3.54E-02	3.60E-02	3.72E-02	3.48E-02	3.19E-02	2.95E-02	2.33E-02
Cranium	2.96E-02	9.50E-02	1.38E-01	1.23E-01	5.51E-02	1.69E-02	1.15E-02	1.11E-02	1.04E-02	9.68E-03	8.83E-03	6.73E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	1.34E-05*	5.47E-05	7.09E-05	7.97E-05	8.54E-05	8.61E-05	8.75E-05	6.47E-05	7.06E-05
Lent. Nucl.	0.00E+00	1.10E-05*	3.21E-04	1.21E-03	1.10E-03	7.10E-04	6.28E-04	6.22E-04	5.63E-04	5.15E-04	4.85E-04	4.01E-04
Mandible	0.00E+00	0.00E+00	7.37E-05	2.55E-03	6.40E-03	3.81E-03	2.50E-03	2.36E-03	2.24E-03	2.09E-03	2.08E-03	1.71E-03
Other Tissues	1.38E-04	8.34E-03	3.01E-02	5.42E-02	4.27E-02	2.94E-02	2.97E-02	3.14E-02	3.00E-02	2.74E-02	2.55E-02	2.03E-02
Skin	2.40E-05	1.25E-03	4.01E-03	5.82E-03	3.70E-03	2.56E-03	2.72E-03	2.90E-03	2.69E-03	2.42E-03	2.22E-03	1.75E-03
Spinal Col.	0.00E+00	1.69E-05*	1.31E-04	2.97E-04	2.73E-04	2.15E-04	2.17E-04	2.09E-04	2.21E-04	1.98E-04	1.81E-04	1.64E-04
Spinal Skel.	5.00E-06*	1.08E-03	5.62E-03	1.81E-02	1.90E-02	8.18E-03	5.23E-03	4.91E-03	4.63E-03	4.20E-03	3.95E-03	3.15E-03
Thalami	0.00E+00	4.49E-05	7.25E-04	2.01E-03	1.51E-03	8.62E-04	8.21E-04	7.98E-04	7.18E-04	6.63E-04	5.99E-04	4.86E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	4.86E-06†	1.73E-05	1.74E-05	1.71E-05	1.93E-05	2.45E-05	2.03E-05	1.80E-05	1.82E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.16E-04	1.05E-03	1.85E-03	2.40E-03	3.49E-03	4.20E-03	4.56E-03	4.68E-03	4.56E-03
White Matter	1.65E-04	1.27E-02	4.52E-02	7.09E-02	4.61E-02	2.72E-02	2.64E-02	2.67E-02	2.48E-02	2.29E-02	2.13E-02	1.73E-02

	Electron Absorbed Fraction of Energy: φ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.87E-01	9.66E-01	9.44E-01	9.22E-01	8.35E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.10E-08‡	1.51E-07‡	7.97E-07*	1.45E-06	2.60E-06	3.11E-06	5.09E-06
Cerebellum	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.73E-01	9.32E-01	8.87E-01	8.43E-01	6.84E-01
Cereb. Cort.	1.69E-05	4.57E-05	6.49E-05	1.37E-04	3.46E-04	1.10E-03	3.38E-03	1.34E-02	3.41E-02	5.65E-02	7.78E-02	1.40E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	2.00E-06‡	7.66E-06	2.19E-05	3.64E-05	4.59E-03	2.16E-02	3.67E-02	4.48E-02	5.47E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.93E-08‡	1.25E-07†	1.72E-07†	6.59E-07	1.07E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.04E-07†	1.28E-06	3.00E-06	3.88E-06	7.48E-06	1.27E-05
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.03E-07‡	2.46E-06*	6.42E-06	1.40E-05	1.93E-05	2.31E-05	4.47E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E-06*	6.39E-06	1.96E-05	6.49E-05	1.98E-04	3.10E-03	9.42E-03	3.71E-02
Skin	0.00E+00	0.00E+00	0.00E+00	6.38E-07‡	0.00E+00	6.33E-07†	2.05E-06	6.11E-06	3.53E-05	8.17E-04	1.97E-03	5.47E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-07†	6.74E-07†	1.50E-06*	3.29E-06	1.22E-05	1.20E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E-06†	8.53E-06	1.97E-05	3.96E-05	3.17E-04	8.70E-04	3.62E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.22E-07‡	5.43E-07*	1.42E-06	3.37E-06	5.50E-06	7.05E-06	1.28E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-08‡	0.00E+00	1.11E-08‡	6.77E-08†	1.71E-07†	3.45E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.04E-07*	4.47E-06	8.29E-06	1.64E-05	2.59E-05	5.87E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	6.18E-07‡	1.42E-06*	8.29E-06	2.31E-05	6.82E-05	1.39E-04	2.00E-04	2.64E-04	1.17E-02

Table A.18: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Cerebral Cortex.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.40E-01	8.23E-01	6.85E-01	4.31E-01	1.94E-01	1.14E-01	1.17E-01	1.22E-01	1.12E-01	1.01E-01	9.12E-02	6.78E-02
Caud. Nucl.	0.00E+00	1.89E-04	9.49E-04	1.77E-03	1.14E-03	6.57E-04	6.24E-04	6.24E-04	5.80E-04	5.29E-04	4.69E-04	3.89E-04
Cerebellum	9.73E-03	2.50E-02	3.31E-02	2.84E-02	1.44E-02	8.35E-03	8.48E-03	8.78E-03	8.05E-03	7.57E-03	6.94E-03	5.59E-03
Cereb. Cort.	8.76E-01	6.57E-01	4.61E-01	2.36E-01	9.49E-02	5.61E-02	5.92E-02	6.24E-02	5.67E-02	5.01E-02	4.46E-02	3.09E-02
Cranium	4.69E-02	1.33E-01	1.68E-01	1.33E-01	5.71E-02	1.73E-02	1.20E-02	1.18E-02	1.10E-02	1.02E-02	9.40E-03	6.88E-03
Eyes	0.00E+00	2.00E-06‡	5.03E-05	3.25E-04	3.59E-04	3.23E-04	3.28E-04	3.74E-04	3.29E-04	3.04E-04	3.04E-04	2.35E-04
Lent. Nucl.	4.89E-05	9.18E-04	2.45E-03	3.38E-03	2.08E-03	1.21E-03	1.14E-03	1.17E-03	1.13E-03	1.01E-03	9.13E-04	7.05E-04
Mandible	5.00E-06*	5.63E-04	2.82E-03	8.89E-03	1.11E-02	5.67E-03	3.84E-03	3.57E-03	3.46E-03	3.22E-03	2.99E-03	2.52E-03
Other Tissues	1.24E-04	5.93E-03	2.01E-02	3.69E-02	3.11E-02	2.22E-02	2.25E-02	2.35E-02	2.26E-02	2.07E-02	1.96E-02	1.57E-02
Skin	7.60E-05	2.65E-03	5.89E-03	6.88E-03	4.06E-03	2.83E-03	3.12E-03	3.29E-03	3.04E-03	2.71E-03	2.47E-03	1.92E-03
Spinal Col.	0.00E+00	2.40E-05	7.84E-05	1.27E-04	1.27E-04	9.61E-05	1.11E-04	1.22E-04	9.49E-05	1.03E-04	7.99E-05	8.34E-05
Spinal Skel.	3.00E-06‡	4.93E-04	2.34E-03	7.66E-03	8.58E-03	3.96E-03	2.55E-03	2.26E-03	2.11E-03	2.04E-03	1.82E-03	1.48E-03
Thalami	5.00E-06†	4.25E-04	1.80E-03	2.68E-03	1.70E-03	1.04E-03	9.52E-04	9.82E-04	9.04E-04	8.45E-04	7.44E-04	6.31E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	5.92E-06*	1.54E-05	1.51E-05	1.20E-05	1.59E-05	1.92E-05	2.02E-05	1.48E-05	1.60E-05
Trunk	0.00E+00	0.00E+00	1.00E-06‡	1.74E-04	9.19E-04	1.29E-03	1.64E-03	2.37E-03	2.85E-03	3.00E-03	3.15E-03	3.07E-03
White Matter	5.42E-02	1.38E-01	1.82E-01	1.54E-01	7.75E-02	4.49E-02	4.49E-02	4.63E-02	4.29E-02	3.93E-02	3.63E-02	2.86E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.80E-01	9.49E-01	9.14E-01	8.80E-01	7.65E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-07‡	5.36E-07*	1.37E-06	3.59E-06	4.85E-06	6.38E-06	7.05E-05
Cerebellum	3.77E-06*	1.28E-05	1.42E-05	3.96E-05	8.75E-05	2.73E-04	7.97E-04	3.02E-03	7.99E-03	1.32E-02	1.81E-02	3.31E-02
Cereb. Cort.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.90E-01	9.60E-01	8.97E-01	8.27E-01	7.58E-01	5.46E-01
Cranium	0.00E+00	6.79E-07‡	1.17E-06‡	4.66E-06*	9.73E-06	1.81E-05	5.53E-05	7.47E-03	3.39E-02	5.64E-02	6.94E-02	7.44E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-07*	1.17E-06*	1.91E-06	3.03E-06*	1.27E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.65E-08‡	1.44E-06*	2.80E-06	4.79E-06	2.69E-05	1.35E-04	1.17E-03
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-07‡	1.88E-06*	5.50E-06	1.26E-05	3.56E-05	1.80E-04	4.23E-04	1.91E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	1.19E-06‡	1.06E-06‡	3.49E-06*	1.57E-05	4.67E-05	1.93E-04	2.60E-03	7.27E-03	2.75E-02
Skin	0.00E+00	0.00E+00	0.00E+00	6.51E-07‡	1.84E-08‡	4.63E-07‡	2.12E-06	1.06E-05	9.12E-05	3.09E-03	6.49E-03	1.21E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-07*	3.63E-07*	9.77E-06	3.37E-05	1.29E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06†	2.36E-06*	9.22E-06	1.76E-05	1.15E-04	3.60E-04	1.77E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.38E-07‡	1.41E-06*	2.43E-06	5.31E-06	7.17E-06	1.01E-05	2.92E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E-08‡	0.00E+00	1.16E-09‡	7.80E-08‡	1.70E-07†	9.32E-09‡	1.96E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.92E-07‡	4.30E-07‡	1.79E-06*	6.02E-06	1.54E-05	1.88E-05	4.19E-05
White Matter	1.33E-05	5.34E-05	7.28E-05	1.69E-04	4.05E-04	1.38E-03	4.34E-03	1.72E-02	4.45E-02	7.37E-02	1.03E-01	1.83E-01

Table A.19: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Cranial CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.90E-01	4.20E-01	3.91E-01	2.77E-01	1.35E-01	8.18E-02	8.38E-02	8.87E-02	8.26E-02	7.50E-02	6.89E-02	5.25E-02
Caud. Nucl.	0.00E+00	6.19E-05	5.27E-04	1.19E-03	7.77E-04	4.93E-04	4.57E-04	4.62E-04	4.31E-04	4.27E-04	3.64E-04	3.06E-04
Cerebellum	5.26E-02	5.52E-02	4.88E-02	3.16E-02	1.46E-02	8.71E-03	8.93E-03	9.55E-03	8.99E-03	8.11E-03	7.40E-03	5.62E-03
Cereb. Cort.	3.36E-01	3.29E-01	2.61E-01	1.50E-01	6.47E-02	3.93E-02	4.12E-02	4.44E-02	4.12E-02	3.71E-02	3.37E-02	2.42E-02
Cranium	4.11E-01	4.34E-01	3.69E-01	2.20E-01	8.00E-02	2.37E-02	1.80E-02	1.81E-02	1.66E-02	1.42E-02	1.22E-02	7.76E-03
Eyes	0.00E+00	1.96E-06‡	6.67E-05	3.23E-04	4.05E-04	3.14E-04	3.36E-04	3.84E-04	3.51E-04	3.31E-04	3.03E-04	2.64E-04
Lent. Nucl.	6.00E-06*	4.11E-04	1.46E-03	2.24E-03	1.49E-03	9.47E-04	8.97E-04	8.83E-04	8.48E-04	7.40E-04	7.35E-04	6.01E-04
Mandible	4.58E-05	1.14E-03	3.89E-03	1.02E-02	1.17E-02	5.82E-03	3.98E-03	3.77E-03	3.59E-03	3.52E-03	3.25E-03	2.68E-03
Other Tissues	7.46E-04	1.48E-02	3.31E-02	4.71E-02	3.58E-02	2.52E-02	2.58E-02	2.77E-02	2.64E-02	2.45E-02	2.27E-02	1.78E-02
Skin	4.67E-04	5.60E-03	9.28E-03	8.97E-03	4.97E-03	3.38E-03	3.81E-03	4.21E-03	3.73E-03	3.30E-03	2.97E-03	2.09E-03
Spinal Col.	3.00E-06†	5.18E-05	1.03E-04	1.57E-04	1.41E-04	1.21E-04	1.34E-04	1.41E-04	1.18E-04	1.19E-04	1.02E-04	8.72E-05
Spinal Skel.	2.50E-05	1.28E-03	4.21E-03	1.01E-02	1.02E-02	4.54E-03	3.02E-03	2.79E-03	2.62E-03	2.38E-03	2.29E-03	1.81E-03
Thalami	0.00E+00	1.73E-04	8.60E-04	1.76E-03	1.23E-03	7.65E-04	7.25E-04	7.65E-04	6.84E-04	6.30E-04	5.49E-04	4.66E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	8.69E-06	1.97E-05	1.44E-05	1.85E-05	1.55E-05	2.40E-05	1.84E-05	1.77E-05	1.31E-05
Trunk	0.00E+00	0.00E+00	1.91E-06‡	1.88E-04	9.57E-04	1.32E-03	1.68E-03	2.37E-03	2.80E-03	3.02E-03	3.03E-03	2.85E-03
White Matter	1.50E-03	3.53E-02	7.73E-02	8.87E-02	5.06E-02	3.06E-02	3.07E-02	3.17E-02	2.96E-02	2.72E-02	2.54E-02	2.07E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	7.65E-04	1.54E-03	2.69E-03	5.57E-03	1.36E-02	4.55E-02	1.42E-01	3.49E-01	4.23E-01	4.42E-01	4.48E-01	4.40E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-08‡	1.76E-07‡	1.61E-06	2.42E-06	3.67E-06	4.55E-06	1.47E-05
Cerebellum	1.11E-04	2.06E-04	3.72E-04	7.56E-04	1.79E-03	5.91E-03	1.86E-02	4.71E-02	5.72E-02	5.95E-02	6.01E-02	5.76E-02
Cereb. Cort.	6.55E-04	1.34E-03	2.32E-03	4.81E-03	1.18E-02	3.96E-02	1.24E-01	3.02E-01	3.66E-01	3.83E-01	3.87E-01	3.27E-01
Cranium	7.94E-04	1.49E-03	2.62E-03	5.45E-03	1.35E-02	4.52E-02	1.41E-01	3.47E-01	4.12E-01	3.46E-01	2.84E-01	1.71E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.56E-08‡	0.00E+00	4.32E-07*	1.49E-06*	2.15E-06	4.79E-06	3.08E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.35E-07‡	8.64E-07†	2.89E-06	5.21E-06	8.44E-06	8.64E-06	4.07E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-06*	3.75E-06	1.32E-05	3.12E-04	1.10E-03	1.81E-03	4.03E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	8.85E-07‡	8.54E-07‡	7.58E-06	2.03E-05	6.69E-05	4.36E-03	3.16E-02	5.05E-02	7.33E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.75E-08‡	1.41E-06*	3.02E-06	1.03E-05	5.41E-03	2.91E-02	3.11E-02	2.44E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.84E-07†	2.98E-07*	1.06E-05	9.86E-05	2.02E-04	3.05E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E-06*	4.48E-06	1.18E-05	1.76E-04	1.77E-03	3.14E-03	5.42E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.95E-07‡	2.00E-06	3.38E-06	6.95E-06	9.33E-06	5.03E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-08‡	7.00E-08*	1.17E-08‡	4.13E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.29E-08‡	4.89E-06	7.82E-06	1.49E-05	2.18E-05	4.28E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	6.58E-07‡	3.91E-06*	1.19E-05	2.70E-05	8.60E-05	1.67E-04	2.83E-04	1.66E-03	5.53E-02

Table A.20: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Cranium.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	5.21E-02	1.57E-01	2.28E-01	2.20E-01	1.20E-01	7.49E-02	7.71E-02	8.07E-02	7.65E-02	7.03E-02	6.48E-02	5.04E-02
Caud. Nucl.	0.00E+00	5.00E-05	3.77E-04	9.23E-04	6.95E-04	4.48E-04	4.22E-04	4.49E-04	4.19E-04	3.81E-04	3.66E-04	2.92E-04
Cerebellum	6.69E-03	2.00E-02	2.81E-02	2.50E-02	1.28E-02	7.97E-03	8.25E-03	8.55E-03	8.24E-03	7.51E-03	6.93E-03	5.32E-03
Cereb. Cort.	4.51E-02	1.19E-01	1.44E-01	1.13E-01	5.65E-02	3.51E-02	3.70E-02	3.94E-02	3.73E-02	3.45E-02	3.14E-02	2.33E-02
Cranium	8.62E-01	6.40E-01	4.52E-01	2.43E-01	8.71E-02	2.62E-02	2.03E-02	2.04E-02	1.75E-02	1.49E-02	1.25E-02	7.97E-03
Eyes	0.00E+00	8.99E-06*	8.67E-05	3.46E-04	3.53E-04	3.13E-04	3.35E-04	3.57E-04	3.47E-04	3.23E-04	3.10E-04	2.73E-04
Lent. Nucl.	3.00E-06†	2.38E-04	1.06E-03	2.03E-03	1.37E-03	8.98E-04	8.54E-04	8.85E-04	8.20E-04	7.21E-04	7.15E-04	5.81E-04
Mandible	7.27E-04	2.68E-03	5.62E-03	1.11E-02	1.18E-02	5.90E-03	4.12E-03	3.96E-03	3.63E-03	3.49E-03	3.28E-03	2.72E-03
Other Tissues	2.05E-02	4.27E-02	5.28E-02	5.23E-02	3.64E-02	2.57E-02	2.68E-02	2.88E-02	2.70E-02	2.51E-02	2.31E-02	1.80E-02
Skin	1.86E-02	2.05E-02	1.67E-02	1.09E-02	5.36E-03	3.68E-03	4.25E-03	4.61E-03	4.14E-03	3.55E-03	3.07E-03	2.10E-03
Spinal Col.	6.66E-05	1.59E-04	1.37E-04	1.75E-04	1.52E-04	1.30E-04	1.25E-04	1.44E-04	1.20E-04	1.18E-04	1.24E-04	9.72E-05
Spinal Skel.	1.24E-03	3.90E-03	6.85E-03	1.16E-02	1.05E-02	4.64E-03	3.10E-03	2.81E-03	2.64E-03	2.43E-03	2.31E-03	1.76E-03
Thalami	1.00E-06‡	1.03E-04	6.38E-04	1.51E-03	1.19E-03	6.98E-04	6.77E-04	6.84E-04	6.76E-04	6.00E-04	5.66E-04	4.77E-04
Thyroid	0.00E+00	0.00E+00	4.77E-08‡	9.86E-06	1.82E-05	1.42E-05	1.46E-05	1.92E-05	2.30E-05	1.84E-05	2.08E-05	1.25E-05
Trunk	0.00E+00	0.00E+00	4.00E-06*	2.16E-04	9.38E-04	1.33E-03	1.65E-03	2.34E-03	2.76E-03	3.04E-03	2.97E-03	2.91E-03
White Matter	3.44E-04	1.77E-02	5.31E-02	7.50E-02	4.65E-02	2.89E-02	2.90E-02	2.99E-02	2.82E-02	2.58E-02	2.41E-02	1.97E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	1.37E-06†	5.05E-06*	1.39E-05	3.74E-05	1.46E-04	2.86E-02	1.30E-01	2.17E-01	2.68E-01	3.37E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E-09‡	8.80E-07*	1.17E-06	2.48E-06	3.60E-06	5.26E-06	1.21E-05
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.56E-07‡	3.61E-06	1.42E-05	3.50E-03	1.69E-02	2.87E-02	3.55E-02	4.36E-02
Cereb. Cort.	0.00E+00	0.00E+00	1.37E-06†	2.75E-06†	1.05E-05*	1.99E-05	9.63E-05	2.50E-02	1.13E-01	1.88E-01	2.31E-01	2.53E-01
Cranium	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.96E-01	9.88E-01	9.63E-01	8.54E-01	6.28E-01	4.57E-01	3.59E-01	2.02E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.34E-07†	7.08E-07*	1.68E-06	2.75E-06	6.10E-06	4.03E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.90E-08‡	7.50E-07*	2.46E-06	5.03E-06	7.22E-06	9.40E-06	2.85E-04
Mandible	0.00E+00	1.77E-06‡	9.73E-07‡	2.38E-06*	1.24E-05	5.22E-05	1.51E-04	5.82E-04	1.63E-03	2.43E-03	3.13E-03	5.13E-03
Other Tissues	2.95E-05	5.73E-05	1.07E-04	2.66E-04	6.36E-04	2.00E-03	6.31E-03	2.36E-02	5.70E-02	7.80E-02	8.67E-02	9.16E-02
Skin	4.58E-05	1.18E-04	1.87E-04	3.68E-04	9.34E-04	3.13E-03	9.84E-03	3.89E-02	6.22E-02	5.75E-02	4.89E-02	3.18E-02
Spinal Col.	7.50E-07‡	0.00E+00	4.03E-07‡	0.00E+00	2.41E-06†	8.81E-06	1.95E-05	8.07E-05	1.95E-04	2.79E-04	3.64E-04	3.92E-04
Spinal Skel.	7.56E-07‡	4.18E-06*	6.43E-06	1.74E-05	3.19E-05	1.06E-04	3.24E-04	1.31E-03	3.24E-03	4.87E-03	5.79E-03	7.07E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.12E-07‡	7.50E-07*	2.46E-06*	3.71E-06	6.42E-06	6.77E-06	2.88E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.31E-07‡	0.00E+00	0.00E+00	7.60E-08‡	5.94E-08†	1.38E-07†	5.06E-07‡
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.90E-08‡	6.24E-07†	3.35E-06	7.85E-06	1.48E-05	2.09E-05	3.79E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	2.30E-06†	2.68E-06†	1.30E-05	3.12E-05	8.71E-05	1.78E-04	2.46E-04	7.99E-04	4.02E-02

Table A.21: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Lateral Ventricles.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.99E-01	9.62E-01	6.92E-01	3.21E-01	1.81E-01	1.79E-01	1.82E-01	1.67E-01	1.51E-01	1.38E-01	1.03E-01
Caud. Nucl.	2.54E-03	1.58E-02	2.03E-02	1.37E-02	5.63E-03	3.08E-03	3.07E-03	3.11E-03	2.99E-03	2.64E-03	2.45E-03	1.85E-03
Cerebellum	1.97E-06‡	1.59E-03	9.34E-03	1.93E-02	1.32E-02	7.64E-03	7.20E-03	7.30E-03	6.72E-03	6.26E-03	5.75E-03	4.70E-03
Cereb. Cort.	4.12E-03	4.55E-02	1.06E-01	1.36E-01	7.79E-02	4.47E-02	4.32E-02	4.36E-02	4.06E-02	3.70E-02	3.47E-02	2.78E-02
Cranium	0.00E+00	6.51E-04	1.57E-02	5.56E-02	4.05E-02	1.37E-02	8.25E-03	7.53E-03	6.88E-03	6.46E-03	5.97E-03	4.88E-03
Eyes	0.00E+00	0.00E+00	1.40E-05	2.07E-04	3.68E-04	2.83E-04	3.16E-04	3.27E-04	2.78E-04	2.75E-04	2.66E-04	2.02E-04
Lent. Nucl.	1.49E-03	1.04E-02	1.80E-02	1.57E-02	7.16E-03	3.98E-03	3.87E-03	3.86E-03	3.54E-03	3.29E-03	3.07E-03	2.33E-03
Mandible	0.00E+00	3.00E-06†	4.51E-04	6.58E-03	1.20E-02	6.63E-03	4.14E-03	3.64E-03	3.43E-03	3.22E-03	2.96E-03	2.47E-03
Other Tissues	0.00E+00	5.80E-05	3.41E-03	2.50E-02	3.10E-02	2.25E-02	2.19E-02	2.21E-02	2.08E-02	1.92E-02	1.82E-02	1.48E-02
Skin	0.00E+00	2.21E-05	6.47E-04	3.04E-03	3.00E-03	2.19E-03	2.21E-03	2.31E-03	2.21E-03	1.94E-03	1.84E-03	1.49E-03
Spinal Col.	0.00E+00	0.00E+00	1.29E-05	8.49E-05	1.12E-04	1.05E-04	9.46E-05	9.35E-05	9.17E-05	9.00E-05	7.16E-05	6.89E-05
Spinal Skel.	0.00E+00	3.93E-06†	3.74E-04	4.82E-03	8.01E-03	4.15E-03	2.48E-03	2.02E-03	1.85E-03	1.70E-03	1.60E-03	1.35E-03
Thalami	2.13E-03	1.42E-02	2.34E-02	1.79E-02	7.68E-03	4.25E-03	4.18E-03	4.27E-03	3.87E-03	3.63E-03	3.35E-03	2.57E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	6.05E-06	1.31E-05	1.38E-05	1.34E-05	1.73E-05	2.37E-05	1.38E-05	1.80E-05	1.96E-05
Trunk	0.00E+00	0.00E+00	3.00E-06†	2.17E-04	1.21E-03	1.69E-03	2.01E-03	2.81E-03	3.63E-03	3.81E-03	4.00E-03	3.99E-03
White Matter	1.70E-01	3.70E-01	4.59E-01	3.60E-01	1.67E-01	9.31E-02	9.14E-02	9.27E-02	8.57E-02	7.83E-02	7.20E-02	5.45E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	4.77E-07‡	7.86E-07‡	4.03E-07‡	3.83E-06	4.29E-06	1.08E-05	3.00E-04	2.93E-03	7.83E-03	2.67E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.50E-07‡	6.38E-07†	7.33E-06	1.92E-05	3.96E-05	5.22E-05	7.06E-05	4.30E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	2.73E-06*	6.61E-06	1.68E-05	3.67E-05	1.21E-04	4.66E-04	3.55E-03	1.13E-02	6.51E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-06‡	6.04E-06*	1.32E-05	3.82E-05	6.43E-05	9.04E-05	1.07E-04	1.67E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.75E-08‡	4.13E-07*	1.71E-06	1.41E-06	1.72E-06	6.23E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	7.96E-07‡	1.82E-06*	1.32E-06*	5.24E-06	1.29E-05	4.46E-04	2.03E-03	4.17E-03	1.39E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.36E-07‡	3.11E-06	1.06E-05	2.09E-05	3.15E-05	4.10E-05	7.38E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.53E-07‡	4.48E-06	1.20E-05	4.74E-05	9.83E-05	1.49E-04	2.01E-04	3.73E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E-07‡	1.95E-06*	5.11E-06	1.05E-05	1.41E-05	1.87E-05	3.86E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E-07‡	2.43E-08‡	5.16E-07	7.35E-07*	1.42E-06*	1.06E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-06†	1.90E-06*	7.61E-06	1.50E-05	2.08E-05	2.25E-05	4.15E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.38E-06*	3.09E-06*	3.84E-06	4.17E-05	7.97E-04	2.65E-03	5.62E-03	2.05E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-08‡	1.94E-07‡	1.25E-08†	5.37E-08‡	1.55E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.34E-07†	3.41E-06	7.15E-06	1.44E-05	2.47E-05	4.99E-05
White Matter	7.95E-05	1.36E-04	2.94E-04	5.82E-04	1.39E-03	4.68E-03	1.46E-02	5.79E-02	1.47E-01	2.35E-01	3.11E-01	4.70E-01

Table A.22: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Lentiform Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.88E-01	9.12E-01	6.24E-01	2.88E-01	1.64E-01	1.63E-01	1.66E-01	1.52E-01	1.37E-01	1.25E-01	9.31E-02
Caud. Nucl.	2.63E-02	4.69E-02	4.19E-02	2.20E-02	8.11E-03	4.54E-03	4.68E-03	4.86E-03	4.58E-03	4.14E-03	3.68E-03	2.51E-03
Cerebellum	0.00E+00	8.15E-05	2.18E-03	8.95E-03	8.02E-03	4.99E-03	4.65E-03	4.60E-03	4.34E-03	3.88E-03	3.64E-03	3.06E-03
Cereb. Cort.	1.65E-03	2.89E-02	7.70E-02	1.05E-01	6.41E-02	3.75E-02	3.62E-02	3.62E-02	3.35E-02	3.10E-02	2.85E-02	2.32E-02
Cranium	4.89E-05	7.95E-03	3.76E-02	7.13E-02	4.48E-02	1.52E-02	9.18E-03	8.30E-03	7.60E-03	7.10E-03	6.58E-03	5.29E-03
Eyes	0.00E+00	0.00E+00	1.12E-05	3.19E-04	5.44E-04	4.67E-04	4.68E-04	4.81E-04	4.50E-04	4.13E-04	3.78E-04	3.00E-04
Lent. Nucl.	8.21E-01	5.46E-01	3.24E-01	1.25E-01	3.97E-02	2.31E-02	2.52E-02	2.65E-02	2.32E-02	1.93E-02	1.60E-02	8.47E-03
Mandible	0.00E+00	3.10E-04	4.20E-03	2.09E-02	2.51E-02	1.18E-02	7.55E-03	6.64E-03	6.10E-03	5.65E-03	5.33E-03	4.34E-03
Other Tissues	4.69E-07‡	2.08E-03	1.89E-02	5.58E-02	5.22E-02	3.58E-02	3.45E-02	3.46E-02	3.22E-02	2.99E-02	2.77E-02	2.25E-02
Skin	0.00E+00	6.92E-06*	4.25E-04	2.47E-03	2.65E-03	2.14E-03	2.17E-03	2.30E-03	2.15E-03	1.96E-03	1.79E-03	1.49E-03
Spinal Col.	0.00E+00	0.00E+00	1.11E-05*	9.53E-05	1.38E-04	1.16E-04	1.08E-04	9.08E-05	9.33E-05	7.84E-05	6.96E-05	6.24E-05
Spinal Skel.	0.00E+00	3.00E-06†	5.14E-04	6.17E-03	9.85E-03	4.89E-03	2.89E-03	2.24E-03	1.97E-03	1.84E-03	1.68E-03	1.31E-03
Thalami	3.48E-02	6.59E-02	6.22E-02	3.47E-02	1.29E-02	7.15E-03	7.42E-03	7.70E-03	7.12E-03	6.52E-03	5.95E-03	4.04E-03
Thyroid	0.00E+00	0.00E+00	9.79E-07‡	1.47E-05*	2.95E-05	2.60E-05	2.39E-05	2.78E-05	2.40E-05	2.25E-05	2.28E-05	2.08E-05
Trunk	0.00E+00	0.00E+00	9.96E-07‡	4.00E-04	1.81E-03	2.22E-03	2.58E-03	3.41E-03	4.05E-03	4.34E-03	4.31E-03	4.24E-03
White Matter	1.15E-01	2.89E-01	3.83E-01	3.10E-01	1.47E-01	8.23E-02	8.08E-02	8.16E-02	7.50E-02	6.88E-02	6.38E-02	4.91E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.81E-01
Caud. Nucl.	1.31E-05	3.25E-05	3.68E-05	1.12E-04	2.19E-04	7.55E-04	2.42E-03	9.28E-03	2.31E-02	3.62E-02	4.76E-02	6.10E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-07†	2.47E-06*	1.12E-05	2.45E-05	3.33E-05	4.54E-05	7.93E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	1.52E-06‡	4.15E-06*	1.25E-05	3.61E-05	9.70E-05	2.00E-04	9.45E-04	3.94E-03	3.78E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-06‡	5.99E-06	2.20E-05	4.51E-05	7.80E-05	1.04E-04	1.21E-04	2.54E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-07†	4.92E-07*	1.71E-06	3.49E-06	3.36E-06	9.04E-06
Lent. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.84E-01	9.38E-01	8.44E-01	7.51E-01	6.63E-01	4.03E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.07E-07‡	3.17E-06†	1.05E-05	2.33E-05	4.78E-05	6.48E-05	7.79E-05	1.32E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	1.43E-07‡	2.05E-07‡	8.97E-06	2.34E-05	7.40E-05	1.61E-04	2.41E-04	3.20E-04	1.72E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.60E-07‡	6.91E-07†	3.98E-06	9.30E-06	1.55E-05	2.16E-05	3.74E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-07‡	2.06E-07*	3.13E-07†	9.17E-07*	6.67E-07	1.47E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	6.44E-07‡	8.64E-07‡	9.30E-07‡	2.78E-06*	7.58E-06	1.62E-05	2.24E-05	2.82E-05	4.81E-05
Thalami	1.55E-05*	2.97E-05	5.99E-05	1.35E-04	3.21E-04	1.07E-03	3.28E-03	1.25E-02	3.07E-02	4.76E-02	6.23E-02	8.75E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-07†	1.04E-07†	4.02E-07*	8.24E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.45E-07‡	3.10E-06	8.94E-06	1.91E-05	2.56E-05	6.11E-05
White Matter	5.23E-05	1.11E-04	1.89E-04	3.89E-04	9.73E-04	3.17E-03	9.96E-03	3.88E-02	9.77E-02	1.57E-01	2.12E-01	3.76E-01

Table A.23: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Spinal CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.20E-05	2.28E-03	9.86E-03	2.58E-02	3.18E-02	2.56E-02	2.55E-02	2.63E-02	2.48E-02	2.28E-02	2.17E-02	1.78E-02
Caud. Nucl.	0.00E+00	0.00E+00	5.96E-06†	9.88E-05	2.14E-04	1.70E-04	1.67E-04	1.62E-04	1.59E-04	1.47E-04	1.26E-04	1.10E-04
Cerebellum	4.00E-06*	4.52E-04	2.27E-03	5.51E-03	5.71E-03	4.36E-03	4.40E-03	4.55E-03	4.37E-03	3.92E-03	3.75E-03	3.04E-03
Cereb. Cort.	2.80E-05	1.63E-03	5.39E-03	1.09E-02	1.23E-02	9.84E-03	1.00E-02	1.04E-02	9.91E-03	9.09E-03	8.64E-03	7.12E-03
Cranium	5.32E-03	1.17E-02	1.39E-02	1.64E-02	1.48E-02	6.44E-03	4.21E-03	3.84E-03	3.47E-03	3.28E-03	3.13E-03	2.47E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	9.71E-07‡	4.06E-05	6.22E-05	7.61E-05	8.18E-05	8.40E-05	8.81E-05	7.47E-05	6.23E-05
Lent. Nucl.	0.00E+00	0.00E+00	2.39E-05	3.00E-04	4.92E-04	4.07E-04	3.94E-04	3.89E-04	3.73E-04	3.49E-04	3.14E-04	2.73E-04
Mandible	0.00E+00	1.00E-06‡	9.19E-05	5.52E-03	1.46E-02	8.38E-03	5.46E-03	4.85E-03	4.52E-03	4.29E-03	3.90E-03	3.25E-03
Other Tissues	0.00E+00	1.73E-04	1.07E-02	8.41E-02	9.75E-02	7.25E-02	7.30E-02	7.54E-02	7.06E-02	6.53E-02	6.08E-02	4.98E-02
Skin	0.00E+00	2.02E-06‡	2.01E-04	1.76E-03	2.32E-03	2.00E-03	2.20E-03	2.43E-03	2.21E-03	2.01E-03	1.80E-03	1.48E-03
Spinal Col.	1.08E-01	1.22E-01	8.15E-02	3.28E-02	1.10E-02	6.63E-03	7.04E-03	7.56E-03	6.94E-03	6.15E-03	5.32E-03	2.90E-03
Spinal Skel.	2.13E-01	4.72E-01	6.46E-01	5.95E-01	2.75E-01	8.70E-02	6.21E-02	6.04E-02	5.56E-02	5.04E-02	4.61E-02	3.42E-02
Thalami	0.00E+00	0.00E+00	8.62E-05	4.04E-04	6.23E-04	4.76E-04	4.59E-04	4.52E-04	4.17E-04	3.83E-04	3.49E-04	2.86E-04
Thyroid	0.00E+00	0.00E+00	3.22E-05	2.76E-04	3.18E-04	2.30E-04	2.18E-04	2.18E-04	2.04E-04	1.77E-04	1.83E-04	1.44E-04
Trunk	5.34E-03	1.37E-02	2.32E-02	4.06E-02	4.66E-02	3.75E-02	3.85E-02	4.20E-02	4.20E-02	4.02E-02	3.81E-02	3.26E-02
White Matter	0.00E+00	2.04E-04	2.05E-03	8.33E-03	1.20E-02	9.94E-03	9.67E-03	9.93E-03	9.22E-03	8.63E-03	8.22E-03	6.72E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-06‡	2.99E-06*	1.18E-05	4.82E-05	1.26E-04	9.38E-04	2.84E-03	1.26E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.44E-07‡	0.00E+00	1.17E-07‡	5.92E-07†	1.79E-06	1.63E-06	2.53E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.88E-08‡	8.84E-07†	1.67E-06*	1.07E-05	2.53E-05	2.07E-04	5.62E-04	2.59E-03
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.59E-07‡	5.17E-07†	5.51E-06	1.79E-05	5.08E-05	6.53E-04	2.18E-03	9.51E-03
Cranium	1.66E-06‡	4.47E-06*	1.05E-05*	2.00E-05	5.27E-05	1.73E-04	5.07E-04	1.97E-03	4.86E-03	6.96E-03	8.09E-03	9.11E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.92E-09‡	2.42E-07‡	5.36E-07*	4.06E-07†	4.48E-07	1.55E-06*
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-08‡	6.19E-07*	2.79E-06	3.00E-06	3.69E-06	6.18E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-06‡	6.91E-07†	6.19E-06	1.61E-05	2.90E-05	4.31E-05	5.49E-05	1.02E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	7.69E-07‡	2.78E-06‡	1.54E-05	3.91E-05	1.40E-04	3.52E-04	5.32E-04	7.02E-04	1.11E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.67E-07‡	1.27E-06*	4.22E-06	1.07E-05	1.50E-05	2.06E-05	3.77E-05
Spinal Col.	4.93E-05	1.12E-04	1.93E-04	3.94E-04	1.04E-03	3.46E-03	1.09E-02	4.29E-02	1.10E-01	1.61E-01	1.77E-01	1.13E-01
Spinal Skel.	9.33E-05	2.19E-04	3.49E-04	7.27E-04	1.73E-03	5.77E-03	1.81E-02	7.21E-02	1.87E-01	2.93E-01	3.66E-01	5.53E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.32E-08‡	9.48E-07	2.74E-06	4.20E-06	4.21E-06	8.77E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-07‡	2.68E-08‡	4.24E-07*	6.56E-07	1.47E-06*	1.52E-06	3.42E-06
Trunk	3.35E-06*	3.30E-06†	7.89E-06*	1.80E-05	4.87E-05	1.54E-04	5.08E-04	1.94E-03	4.98E-03	8.26E-03	1.14E-02	2.35E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.51E-08‡	9.45E-07*	4.15E-06	1.70E-05	4.14E-05	6.78E-05	9.30E-05	4.80E-04

Table A.24: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Spinal Skeleton.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	7.99E-06*	8.01E-04	4.95E-03	2.08E-02	3.04E-02	2.50E-02	2.50E-02	2.56E-02	2.44E-02	2.28E-02	2.12E-02	1.74E-02
Caud. Nucl.	0.00E+00	0.00E+00	4.17E-06*	9.60E-05	1.84E-04	1.61E-04	1.65E-04	1.60E-04	1.61E-04	1.35E-04	1.33E-04	9.73E-05
Cerebellum	3.02E-06†	2.18E-04	1.34E-03	4.51E-03	5.46E-03	4.32E-03	4.43E-03	4.49E-03	4.25E-03	4.02E-03	3.66E-03	3.06E-03
Cereb. Cort.	4.97E-06†	5.03E-04	2.41E-03	8.51E-03	1.16E-02	9.58E-03	9.70E-03	1.02E-02	9.72E-03	9.02E-03	8.51E-03	6.87E-03
Cranium	1.56E-03	4.50E-03	7.91E-03	1.42E-02	1.41E-02	6.36E-03	4.09E-03	3.81E-03	3.60E-03	3.30E-03	3.12E-03	2.43E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	5.92E-06*	3.58E-05	6.46E-05	8.53E-05	7.46E-05	7.75E-05	7.72E-05	8.64E-05	5.84E-05
Lent. Nucl.	0.00E+00	0.00E+00	2.16E-05	2.81E-04	5.11E-04	4.20E-04	4.00E-04	3.86E-04	3.81E-04	3.46E-04	3.23E-04	2.60E-04
Mandible	0.00E+00	5.99E-06†	4.62E-04	6.85E-03	1.48E-02	8.38E-03	5.48E-03	4.89E-03	4.56E-03	4.29E-03	3.99E-03	3.35E-03
Other Tissues	1.48E-02	4.40E-02	8.06E-02	1.27E-01	1.08E-01	7.81E-02	7.95E-02	8.26E-02	7.73E-02	7.14E-02	6.64E-02	5.33E-02
Skin	4.00E-06‡	2.80E-04	1.12E-03	2.41E-03	2.51E-03	2.08E-03	2.21E-03	2.49E-03	2.29E-03	2.03E-03	1.86E-03	1.53E-03
Spinal Col.	5.91E-04	4.12E-03	6.72E-03	6.65E-03	3.62E-03	2.36E-03	2.48E-03	2.60E-03	2.41E-03	2.20E-03	2.03E-03	1.54E-03
Spinal Skel.	9.75E-01	9.23E-01	8.42E-01	6.16E-01	2.78E-01	8.98E-02	6.66E-02	6.54E-02	5.90E-02	5.22E-02	4.63E-02	3.18E-02
Thalami	0.00E+00	0.00E+00	4.51E-05	3.70E-04	5.77E-04	4.45E-04	4.56E-04	4.50E-04	4.31E-04	3.62E-04	3.87E-04	2.91E-04
Thyroid	0.00E+00	3.29E-05*	1.68E-04	3.14E-04	3.07E-04	2.20E-04	2.40E-04	2.22E-04	2.07E-04	1.82E-04	1.72E-04	1.44E-04
Trunk	1.38E-03	5.22E-03	1.27E-02	3.20E-02	4.19E-02	3.45E-02	3.62E-02	3.97E-02	4.02E-02	3.80E-02	3.66E-02	3.11E-02
White Matter	0.00E+00	7.90E-05	1.11E-03	6.79E-03	1.16E-02	9.67E-03	9.43E-03	9.64E-03	9.10E-03	8.64E-03	7.95E-03	6.61E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06†	3.00E-06*	1.69E-05	6.31E-05	1.40E-04	7.80E-04	2.33E-03	1.10E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-08‡	1.28E-07‡	4.43E-07†	8.14E-07*	6.96E-07	2.15E-06	3.60E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.42E-08‡	5.18E-07‡	2.43E-06*	1.05E-05	2.90E-05	2.58E-04	7.87E-04	3.35E-03
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-07‡	1.11E-06†	7.38E-06	2.54E-05	5.56E-05	4.32E-04	1.43E-03	7.16E-03
Cranium	2.39E-06†	3.32E-06*	9.81E-06	1.39E-05	3.04E-05	1.19E-04	3.85E-04	1.52E-03	3.82E-03	5.65E-03	6.60E-03	8.40E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.97E-07‡	1.55E-07‡	4.18E-07*	8.76E-07*	1.13E-06	6.27E-07
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.71E-08‡	2.34E-07*	8.57E-07*	2.12E-06	3.56E-06	3.99E-06	8.05E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.19E-07‡	9.83E-07†	5.96E-06*	2.05E-05	3.41E-05	5.46E-05	6.35E-05	1.09E-04
Other Tissues	2.45E-05	4.66E-05	7.69E-05	1.49E-04	4.17E-04	1.25E-03	3.88E-03	1.53E-02	3.96E-02	6.64E-02	9.38E-02	1.93E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-06†	8.73E-08‡	1.79E-06*	6.02E-06	1.24E-05	1.85E-05	2.82E-05	1.03E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-06‡	9.09E-07*	1.89E-06*	8.47E-06	3.68E-05	1.77E-03	6.17E-03	2.27E-02
Spinal Skel.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.72E-01	9.27E-01	8.79E-01	8.29E-01	6.52E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E-09‡	7.30E-08†	1.15E-06	2.38E-06	3.71E-06	5.72E-06	9.51E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E-07‡	2.79E-07†	1.09E-06	1.23E-06	2.10E-06	2.31E-05
Trunk	9.03E-07‡	1.38E-06†	4.89E-06*	1.20E-05*	4.31E-05	1.23E-04	3.56E-04	1.52E-03	3.88E-03	6.51E-03	9.51E-03	2.09E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.90E-07‡	1.32E-06†	6.37E-06	2.38E-05	4.74E-05	7.99E-05	1.01E-04	4.52E-04

Table A.25: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Thalami.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.94E-01	9.36E-01	6.55E-01	3.06E-01	1.73E-01	1.72E-01	1.74E-01	1.59E-01	1.44E-01	1.31E-01	9.80E-02
Caud. Nucl.	4.42E-03	1.58E-02	1.89E-02	1.28E-02	5.34E-03	2.90E-03	2.90E-03	3.04E-03	2.76E-03	2.53E-03	2.37E-03	1.73E-03
Cerebellum	0.00E+00	4.58E-04	6.38E-03	1.75E-02	1.30E-02	7.66E-03	7.18E-03	6.96E-03	6.55E-03	5.99E-03	5.53E-03	4.50E-03
Cereb. Cort.	1.56E-04	1.63E-02	6.55E-02	1.05E-01	6.60E-02	3.86E-02	3.66E-02	3.66E-02	3.39E-02	3.12E-02	2.90E-02	2.35E-02
Cranium	3.00E-06‡	3.95E-03	2.78E-02	6.59E-02	4.46E-02	1.50E-02	9.08E-03	8.04E-03	7.45E-03	6.87E-03	6.35E-03	5.15E-03
Eyes	0.00E+00	0.00E+00	4.00E-06†	1.61E-04	3.53E-04	3.23E-04	3.27E-04	3.37E-04	3.06E-04	2.78E-04	2.68E-04	2.39E-04
Lent. Nucl.	4.19E-02	7.97E-02	7.60E-02	4.19E-02	1.57E-02	8.80E-03	9.04E-03	9.42E-03	8.57E-03	7.80E-03	7.14E-03	4.96E-03
Mandible	0.00E+00	5.28E-05	2.05E-03	1.63E-02	2.22E-02	1.08E-02	6.76E-03	5.84E-03	5.42E-03	5.07E-03	4.66E-03	3.90E-03
Other Tissues	0.00E+00	1.29E-03	1.75E-02	6.09E-02	5.75E-02	3.89E-02	3.72E-02	3.73E-02	3.44E-02	3.18E-02	2.98E-02	2.42E-02
Skin	0.00E+00	9.92E-07‡	2.82E-04	2.20E-03	2.70E-03	2.04E-03	2.10E-03	2.32E-03	2.06E-03	1.88E-03	1.77E-03	1.45E-03
Spinal Col.	0.00E+00	1.00E-06‡	4.10E-05	1.98E-04	2.44E-04	1.65E-04	1.48E-04	1.49E-04	1.38E-04	1.26E-04	1.05E-04	8.76E-05
Spinal Skel.	0.00E+00	4.58E-05	1.58E-03	1.13E-02	1.47E-02	6.78E-03	3.89E-03	3.17E-03	2.81E-03	2.53E-03	2.39E-03	1.96E-03
Thalami	8.41E-01	5.67E-01	3.39E-01	1.32E-01	4.20E-02	2.42E-02	2.64E-02	2.77E-02	2.46E-02	2.04E-02	1.70E-02	8.96E-03
Thyroid	0.00E+00	0.00E+00	2.00E-06‡	2.04E-05*	3.07E-05	3.03E-05	2.97E-05	2.85E-05	3.25E-05	2.51E-05	2.22E-05	2.07E-05
Trunk	0.00E+00	0.00E+00	6.00E-06*	5.42E-04	2.19E-03	2.64E-03	3.07E-03	4.16E-03	4.92E-03	5.26E-03	5.28E-03	5.08E-03
White Matter	1.07E-01	2.85E-01	3.89E-01	3.18E-01	1.52E-01	8.45E-02	8.30E-02	8.37E-02	7.68E-02	7.03E-02	6.49E-02	5.03E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.85E-01
Caud. Nucl.	0.00E+00	0.00E+00	4.01E-07‡	0.00E+00	1.94E-07‡	2.97E-06	2.11E-05	3.64E-04	2.46E-03	6.19E-03	1.05E-02	2.38E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.62E-07‡	1.36E-06*	5.98E-06	1.76E-05	3.56E-05	5.17E-05	6.53E-05	1.26E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	5.84E-07‡	4.57E-06	1.01E-05	3.00E-05	9.51E-05	1.90E-04	2.80E-04	3.67E-04	1.18E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-06†	7.15E-06	1.50E-05	4.32E-05	7.76E-05	9.98E-05	1.16E-04	3.42E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.86E-07†	1.74E-06	2.26E-06	3.20E-06	5.30E-06
Lent. Nucl.	2.39E-05	4.78E-05	6.32E-05	1.53E-04	3.90E-04	1.26E-03	3.87E-03	1.53E-02	3.71E-02	5.80E-02	7.55E-02	1.06E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.21E-06*	7.50E-06	2.18E-05	3.91E-05	5.70E-05	7.38E-05	1.27E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-06‡	8.84E-06	2.98E-05	8.20E-05	1.78E-04	2.73E-04	3.39E-04	6.58E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.81E-08‡	1.92E-06*	4.78E-06	9.28E-06	1.44E-05	1.84E-05	3.67E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.37E-09‡	1.63E-07*	1.01E-06*	1.17E-06*	1.81E-06	2.53E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.92E-07‡	1.95E-06*	3.23E-06*	1.22E-05	2.49E-05	3.43E-05	4.37E-05	6.85E-05
Thalami	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.96E-01	9.87E-01	9.49E-01	8.67E-01	7.78E-01	6.91E-01	4.17E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.52E-08‡	8.18E-08†	6.68E-08†	1.73E-07*	7.96E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.88E-07†	8.09E-06	1.46E-05	2.53E-05	3.11E-05	8.07E-05
White Matter	4.59E-05	8.46E-05	1.47E-04	3.29E-04	8.29E-04	2.61E-03	8.43E-03	3.41E-02	8.86E-02	1.45E-01	1.99E-01	3.81E-01

Table A.26: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Third Ventricle.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.97E-01	9.50E-01	6.79E-01	3.17E-01	1.79E-01	1.77E-01	1.80E-01	1.64E-01	1.48E-01	1.36E-01	1.02E-01
Caud. Nucl.	1.80E-05	3.78E-03	1.02E-02	9.71E-03	4.44E-03	2.46E-03	2.35E-03	2.41E-03	2.23E-03	1.97E-03	1.92E-03	1.51E-03
Cerebellum	0.00E+00	4.82E-04	6.43E-03	1.82E-02	1.33E-02	7.73E-03	7.33E-03	7.14E-03	6.69E-03	6.13E-03	5.69E-03	4.82E-03
Cereb. Cort.	4.09E-05	1.06E-02	5.72E-02	1.03E-01	6.69E-02	3.88E-02	3.70E-02	3.66E-02	3.37E-02	3.09E-02	2.87E-02	2.34E-02
Cranium	0.00E+00	1.92E-03	2.13E-02	6.00E-02	4.34E-02	1.48E-02	8.77E-03	7.80E-03	7.07E-03	6.62E-03	6.12E-03	4.96E-03
Eyes	0.00E+00	0.00E+00	5.02E-06†	1.79E-04	3.56E-04	3.03E-04	3.37E-04	3.46E-04	3.14E-04	2.79E-04	2.71E-04	2.24E-04
Lent. Nucl.	3.68E-04	1.52E-02	3.17E-02	2.57E-02	1.10E-02	5.93E-03	5.85E-03	6.00E-03	5.51E-03	5.03E-03	4.69E-03	3.74E-03
Mandible	0.00E+00	1.30E-05	1.27E-03	1.34E-02	2.00E-02	9.96E-03	6.22E-03	5.33E-03	4.90E-03	4.55E-03	4.30E-03	3.59E-03
Other Tissues	0.00E+00	6.68E-04	1.27E-02	5.25E-02	5.25E-02	3.61E-02	3.41E-02	3.42E-02	3.20E-02	2.94E-02	2.70E-02	2.21E-02
Skin	0.00E+00	1.00E-06‡	2.56E-04	2.17E-03	2.64E-03	2.04E-03	2.09E-03	2.23E-03	2.05E-03	1.88E-03	1.74E-03	1.41E-03
Spinal Col.	0.00E+00	1.00E-06‡	4.68E-05	2.04E-04	2.11E-04	1.69E-04	1.40E-04	1.46E-04	1.33E-04	1.08E-04	1.08E-04	8.50E-05
Spinal Skel.	0.00E+00	2.79E-05	1.34E-03	1.03E-02	1.39E-02	6.47E-03	3.77E-03	3.06E-03	2.72E-03	2.40E-03	2.21E-03	1.76E-03
Thalami	3.41E-02	1.42E-01	1.41E-01	7.20E-02	2.50E-02	1.39E-02	1.46E-02	1.54E-02	1.43E-02	1.33E-02	1.22E-02	8.22E-03
Thyroid	0.00E+00	0.00E+00	1.93E-06‡	1.25E-05	2.33E-05	2.69E-05	2.27E-05	2.91E-05	3.43E-05	3.31E-05	2.05E-05	2.26E-05
Trunk	0.00E+00	0.00E+00	5.94E-06†	4.35E-04	2.08E-03	2.48E-03	2.89E-03	4.01E-03	4.78E-03	5.10E-03	5.21E-03	5.02E-03
White Matter	3.78E-01	5.10E-01	5.16E-01	3.70E-01	1.70E-01	9.45E-02	9.36E-02	9.52E-02	8.75E-02	7.89E-02	7.23E-02	5.38E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	8.61E-07‡	1.02E-08‡	2.77E-06*	2.76E-06	7.93E-06	1.38E-05	1.88E-05	2.68E-05	1.40E-03
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.18E-07‡	3.82E-07‡	5.11E-06	1.85E-05	3.95E-05	5.58E-05	7.06E-05	1.30E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.29E-07‡	4.60E-06*	1.50E-05	3.25E-05	1.02E-04	1.91E-04	2.80E-04	3.59E-04	2.68E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E-06†	7.96E-06*	1.34E-05	4.31E-05	6.76E-05	9.53E-05	1.10E-04	1.89E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-07‡	3.27E-07†	1.65E-06*	2.58E-06	1.91E-06	4.62E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E-06†	3.09E-06*	9.11E-06	2.02E-05	3.72E-05	5.77E-05	2.52E-04	1.77E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.25E-07†	6.48E-06*	1.98E-05	3.46E-05	4.94E-05	6.34E-05	1.04E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-06†	6.58E-06	2.09E-05	7.42E-05	1.61E-04	2.44E-04	3.09E-04	5.86E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.87E-07†	2.40E-06	4.44E-06	1.03E-05	1.32E-05	1.73E-05	3.27E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.58E-07†	8.33E-07*	1.47E-06	1.58E-06	2.60E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-06*	3.99E-06*	1.27E-05	2.35E-05	3.56E-05	3.82E-05	6.34E-05
Thalami	0.00E+00	0.00E+00	3.61E-06*	2.25E-06*	9.53E-06	1.19E-05	2.86E-05	6.21E-05	2.73E-03	4.07E-02	1.11E-01	2.39E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-07‡	3.01E-07‡	4.14E-07*	6.15E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.81E-07‡	1.19E-06†	3.72E-06	1.16E-05	1.92E-05	2.92E-05	7.00E-05
White Matter	2.27E-04	4.63E-04	8.33E-04	1.65E-03	4.18E-03	1.35E-02	4.26E-02	1.68E-01	4.03E-01	5.38E-01	5.63E-01	5.24E-01

Table A.27: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the Thyroid.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	1.10E-04	3.81E-03	8.65E-03	8.21E-03	8.63E-03	9.63E-03	9.52E-03	9.15E-03	8.80E-03	7.39E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	2.85E-05	7.13E-05	6.91E-05	8.25E-05	8.40E-05	8.07E-05	7.43E-05	7.73E-05	6.89E-05
Cerebellum	0.00E+00	0.00E+00	3.95E-06*	1.94E-04	7.43E-04	8.02E-04	8.55E-04	1.01E-03	9.80E-04	9.64E-04	9.36E-04	7.88E-04
Cereb. Cort.	0.00E+00	0.00E+00	6.69E-05	1.52E-03	3.26E-03	3.13E-03	3.34E-03	3.81E-03	3.78E-03	3.64E-03	3.51E-03	2.95E-03
Cranium	0.00E+00	0.00E+00	1.21E-04	1.91E-03	3.49E-03	1.93E-03	1.26E-03	1.18E-03	1.14E-03	1.11E-03	1.07E-03	9.24E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	1.55E-07‡	3.55E-05	5.31E-05	6.19E-05	7.59E-05	7.68E-05	6.53E-05	6.54E-05	6.30E-05
Lent. Nucl.	0.00E+00	0.00E+00	1.00E-06‡	9.45E-05	2.43E-04	1.98E-04	1.91E-04	2.05E-04	2.01E-04	1.67E-04	1.60E-04	1.36E-04
Mandible	0.00E+00	1.17E-04	2.89E-03	1.72E-02	1.94E-02	8.62E-03	5.34E-03	4.62E-03	4.23E-03	3.90E-03	3.58E-03	3.06E-03
Other Tissues	2.84E-01	5.12E-01	5.15E-01	3.34E-01	1.51E-01	9.04E-02	9.26E-02	9.72E-02	9.11E-02	8.39E-02	7.65E-02	5.76E-02
Skin	2.20E-05	1.74E-03	4.11E-03	4.10E-03	2.43E-03	1.63E-03	1.73E-03	1.88E-03	1.74E-03	1.55E-03	1.45E-03	1.19E-03
Spinal Col.	0.00E+00	0.00E+00	1.01E-04	7.44E-04	7.52E-04	5.25E-04	5.48E-04	5.75E-04	5.13E-04	4.76E-04	4.53E-04	3.58E-04
Spinal Skel.	1.30E-05	6.58E-03	3.30E-02	7.19E-02	5.46E-02	2.03E-02	1.31E-02	1.21E-02	1.11E-02	1.03E-02	9.43E-03	7.85E-03
Thalami	0.00E+00	0.00E+00	3.98E-06*	1.10E-04	1.91E-04	1.63E-04	1.63E-04	1.70E-04	1.42E-04	1.47E-04	1.60E-04	1.23E-04
Thyroid	6.99E-01	3.84E-01	2.03E-01	7.00E-02	2.08E-02	1.23E-02	1.39E-02	1.46E-02	1.21E-02	9.49E-03	7.28E-03	3.28E-03
Trunk	1.57E-02	7.73E-02	1.56E-01	2.13E-01	1.50E-01	9.58E-02	9.44E-02	9.89E-02	9.48E-02	8.87E-02	8.33E-02	6.85E-02
White Matter	0.00E+00	0.00E+00	3.27E-05	1.81E-03	3.97E-03	3.71E-03	3.85E-03	4.21E-03	4.19E-03	4.02E-03	3.82E-03	3.21E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.51E-07‡	4.28E-06	1.40E-05	3.46E-05	5.34E-05	7.33E-05	1.61E-04
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.33E-08†	2.90E-07†	1.55E-07*	9.15E-07†	1.02E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-08‡	2.59E-07†	1.35E-06*	3.35E-06	5.40E-06	8.93E-06	1.77E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-07‡	2.14E-06*	5.39E-06	1.43E-05	2.10E-05	2.75E-05	6.35E-05
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.60E-07‡	8.70E-07†	9.95E-07†	2.91E-06	7.16E-06	1.07E-05	1.26E-05	2.31E-05
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.79E-09‡	1.17E-08‡	1.07E-07*	6.22E-07†	6.87E-07*	1.19E-06*
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.46E-07‡	2.53E-07*	4.87E-07*	1.16E-06	1.42E-06	2.72E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.74E-07‡	2.27E-06*	7.29E-06	1.55E-05	3.36E-05	4.49E-05	5.89E-05	9.56E-05
Other Tissues	1.55E-04	3.01E-04	5.34E-04	1.06E-03	2.75E-03	9.03E-03	2.81E-02	1.08E-01	2.60E-01	3.98E-01	5.03E-01	6.39E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-07‡	1.97E-06*	3.35E-06	8.24E-06	1.15E-05	1.74E-05	1.50E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.91E-09‡	2.83E-07‡	1.14E-06*	3.13E-06	3.29E-06	4.77E-06	9.21E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E-06‡	1.07E-05	1.89E-05	5.30E-05	1.00E-04	1.35E-04	1.55E-04	1.33E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E-07‡	2.67E-07†	8.30E-07*	1.17E-06	1.47E-06	2.35E-06
Thyroid	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.97E-01	9.91E-01	9.71E-01	8.88E-01	7.26E-01	5.73E-01	4.51E-01	2.32E-01
Trunk	8.11E-07‡	0.00E+00	9.66E-07‡	5.32E-06†	2.21E-05	8.12E-05	3.53E-04	2.45E-03	9.84E-03	2.16E-02	3.61E-02	1.02E-01
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.08E-07‡	1.02E-06†	6.49E-06	1.50E-05	2.40E-05	3.18E-05	7.18E-05

Table A.28: Absorbed Fractions for the 1-year-old Phantom for Sources Located in the White Matter.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.72E-01	8.68E-01	5.69E-01	2.56E-01	1.46E-01	1.48E-01	1.52E-01	1.40E-01	1.26E-01	1.15E-01	8.48E-02
Caud. Nucl.	2.78E-03	6.61E-03	8.25E-03	6.24E-03	2.78E-03	1.59E-03	1.57E-03	1.55E-03	1.47E-03	1.33E-03	1.20E-03	9.32E-04
Cerebellum	3.10E-05	2.87E-03	1.04E-02	1.64E-02	1.06E-02	6.23E-03	6.08E-03	6.13E-03	5.65E-03	5.23E-03	4.92E-03	4.06E-03
Cereb. Cort.	5.34E-02	1.35E-01	1.78E-01	1.51E-01	7.57E-02	4.38E-02	4.38E-02	4.53E-02	4.22E-02	3.86E-02	3.56E-02	2.79E-02
Cranium	3.93E-04	1.93E-02	6.01E-02	8.41E-02	4.59E-02	1.48E-02	9.59E-03	8.95E-03	8.32E-03	7.68E-03	7.21E-03	5.73E-03
Eyes	0.00E+00	2.00E-06‡	4.71E-05	3.59E-04	4.49E-04	3.56E-04	3.99E-04	4.25E-04	3.90E-04	3.43E-04	3.15E-04	2.58E-04
Lent. Nucl.	3.58E-03	8.98E-03	1.18E-02	9.66E-03	4.67E-03	2.56E-03	2.51E-03	2.58E-03	2.35E-03	2.17E-03	2.08E-03	1.53E-03
Mandible	0.00E+00	1.66E-04	1.63E-03	8.81E-03	1.28E-02	6.68E-03	4.33E-03	3.92E-03	3.63E-03	3.48E-03	3.25E-03	2.75E-03
Other Tissues	0.00E+00	1.39E-03	1.07E-02	3.24E-02	3.20E-02	2.31E-02	2.27E-02	2.38E-02	2.23E-02	2.06E-02	1.91E-02	1.56E-02
Skin	1.00E-06‡	4.23E-04	2.29E-03	4.48E-03	3.44E-03	2.37E-03	2.55E-03	2.73E-03	2.51E-03	2.25E-03	2.09E-03	1.66E-03
Spinal Col.	0.00E+00	9.89E-07‡	3.17E-05	1.00E-04	1.21E-04	1.02E-04	9.24E-05	9.25E-05	8.80E-05	8.11E-05	6.37E-05	5.70E-05
Spinal Skel.	0.00E+00	8.96E-05	9.51E-04	5.49E-03	7.89E-03	3.78E-03	2.38E-03	1.99E-03	1.81E-03	1.67E-03	1.55E-03	1.25E-03
Thalami	2.71E-03	7.41E-03	9.93E-03	8.06E-03	3.87E-03	2.21E-03	2.11E-03	2.18E-03	1.99E-03	1.76E-03	1.65E-03	1.29E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	7.11E-06*	1.95E-05	1.39E-05	1.62E-05	1.65E-05	2.13E-05	1.51E-05	1.68E-05	1.80E-05
Trunk	0.00E+00	0.00E+00	2.96E-06‡	2.03E-04	1.09E-03	1.49E-03	1.80E-03	2.53E-03	3.12E-03	3.32E-03	3.44E-03	3.31E-03
White Matter	9.30E-01	7.98E-01	6.34E-01	3.66E-01	1.52E-01	8.66E-02	8.87E-02	9.09E-02	8.32E-02	7.45E-02	6.66E-02	4.71E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.97E-01	9.95E-01	9.93E-01	9.62E-01
Caud. Nucl.	0.00E+00	4.54E-07‡	3.46E-06*	1.06E-05	2.65E-05	7.84E-05	2.33E-04	8.98E-04	2.31E-03	3.75E-03	5.05E-03	8.45E-03
Cerebellum	0.00E+00	0.00E+00	6.18E-07‡	6.56E-07‡	1.06E-06‡	3.12E-06	4.51E-06	1.40E-05	3.32E-05	4.97E-05	5.82E-05	2.72E-03
Cereb. Cort.	2.77E-05	4.04E-05	8.09E-05	1.64E-04	4.15E-04	1.35E-03	4.28E-03	1.67E-02	4.38E-02	7.29E-02	1.01E-01	1.80E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	7.87E-07‡	3.10E-06*	8.46E-06	2.33E-05	5.29E-05	8.45E-05	1.19E-04	2.78E-04	1.18E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-07‡	5.30E-07†	1.63E-06	2.63E-06	4.74E-06	1.10E-05
Lent. Nucl.	1.45E-06‡	2.68E-06†	9.14E-06*	1.30E-05	3.56E-05	1.00E-04	2.90E-04	1.20E-03	3.11E-03	4.99E-03	6.74E-03	1.16E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E-06*	4.01E-06	1.36E-05	2.38E-05	3.70E-05	4.03E-05	2.15E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-06‡	5.33E-06	1.64E-05	4.45E-05	1.06E-04	1.61E-04	2.05E-04	2.59E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.59E-07‡	3.51E-07‡	1.76E-06*	6.66E-06	9.82E-06	2.00E-05	2.57E-05	1.17E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-08‡	0.00E+00	9.38E-08‡	8.70E-08‡	3.94E-07†	7.97E-07*	6.47E-07*	5.04E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.87E-07‡	1.83E-06*	1.63E-06*	7.98E-06	1.70E-05	1.89E-05	2.41E-05	1.07E-04
Thalami	1.20E-06‡	1.69E-06‡	6.44E-06	1.15E-05	1.77E-05	7.89E-05	2.10E-04	8.85E-04	2.29E-03	3.77E-03	5.26E-03	9.54E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.43E-09‡	2.08E-07†	1.82E-07‡	8.48E-08*	1.01E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-06†	3.74E-06*	5.69E-06	1.42E-05	1.83E-05	4.49E-05
White Matter	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.77E-01	9.39E-01	9.00E-01	8.63E-01	7.33E-01

Absorbed Fractions of Energy in a Mathematical Model of the Head and Brain of a Five Year-Old

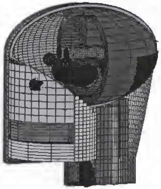


Table A.29: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Brain (Total).

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.74E-01	9.13E-01	8.05E-01	5.45E-01	2.60E-01	1.52E-01	1.52E-01	1.55E-01	1.42E-01	1.29E-01	1.17E-01	8.77E-02
Caud. Nucl.	7.27E-03	7.39E-03	7.06E-03	5.24E-03	2.56E-03	1.44E-03	1.44E-03	1.39E-03	1.34E-03	1.22E-03	1.06E-03	8.20E-04
Cerebellum	9.99E-02	9.11E-02	7.84E-02	5.18E-02	2.41E-02	1.42E-02	1.43E-02	1.47E-02	1.35E-02	1.21E-02	1.11E-02	8.18E-03
Cereb. Cort.	3.83E-01	3.40E-01	2.88E-01	1.88E-01	8.98E-02	5.34E-02	5.39E-02	5.55E-02	5.10E-02	4.60E-02	4.18E-02	3.14E-02
Cranium	1.72E-02	7.17E-02	1.34E-01	1.60E-01	8.80E-02	2.94E-02	1.92E-02	1.78E-02	1.67E-02	1.54E-02	1.43E-02	1.15E-02
Eyes	0.00E+00	1.69E-05*	1.62E-04	5.40E-04	6.10E-04	4.61E-04	4.80E-04	5.06E-04	4.72E-04	4.44E-04	4.11E-04	3.36E-04
Lent. Nucl.	1.33E-02	1.32E-02	1.25E-02	9.04E-03	4.40E-03	2.51E-03	2.48E-03	2.52E-03	2.32E-03	2.07E-03	1.90E-03	1.38E-03
Mandible	1.00E-06‡	9.07E-05	9.23E-04	5.95E-03	1.06E-02	6.24E-03	4.08E-03	3.68E-03	3.42E-03	3.22E-03	3.07E-03	2.61E-03
Other Tissues	1.97E-06‡	1.13E-03	8.33E-03	2.82E-02	3.13E-02	2.40E-02	2.36E-02	2.44E-02	2.34E-02	2.18E-02	2.03E-02	1.67E-02
Skin	1.00E-06‡	3.97E-04	2.05E-03	4.53E-03	3.67E-03	2.70E-03	2.96E-03	3.15E-03	2.94E-03	2.64E-03	2.44E-03	1.97E-03
Spinal Col.	0.00E+00	4.00E-06*	1.83E-05	9.98E-05	1.12E-04	8.64E-05	1.03E-04	9.63E-05	9.47E-05	9.10E-05	8.22E-05	6.80E-05
Spinal Skel.	0.00E+00	9.67E-05	8.72E-04	5.25E-03	7.70E-03	4.13E-03	2.53E-03	2.16E-03	2.02E-03	1.87E-03	1.75E-03	1.48E-03
Thalami	1.13E-02	1.14E-02	1.07E-02	8.08E-03	4.01E-03	2.28E-03	2.22E-03	2.24E-03	2.04E-03	1.85E-03	1.68E-03	1.30E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.21E-05	2.68E-05	1.89E-05	1.99E-05	2.86E-05	2.82E-05	3.00E-05	3.10E-05	1.83E-05
Trunk	0.00E+00	0.00E+00	1.00E-06‡	1.39E-04	9.55E-04	1.56E-03	1.88E-03	2.74E-03	3.37E-03	3.85E-03	3.84E-03	3.87E-03
White Matter	4.44E-01	4.34E-01	3.94E-01	2.71E-01	1.30E-01	7.48E-02	7.45E-02	7.60E-02	6.94E-02	6.28E-02	5.73E-02	4.28E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.91E-01	9.76E-01	9.61E-01	9.45E-01	8.82E-01
Caud. Nucl.	7.27E-03	7.42E-03	7.42E-03	7.31E-03	7.39E-03	7.46E-03	7.36E-03	7.45E-03	7.39E-03	7.39E-03	7.33E-03	7.32E-03
Cerebellum	1.02E-01	1.03E-01	1.02E-01	1.02E-01	1.03E-01	1.02E-01	1.02E-01	1.01E-01	9.93E-02	9.73E-02	9.55E-02	8.70E-02
Cereb. Cort.	4.06E-01	4.05E-01	4.06E-01	4.06E-01	4.06E-01	4.05E-01	4.04E-01	3.99E-01	3.87E-01	3.75E-01	3.62E-01	3.17E-01
Cranium	0.00E+00	4.15E-07‡	0.00E+00	2.39E-06*	7.63E-06*	2.10E-05	4.31E-05	1.20E-03	1.11E-02	2.39E-02	3.55E-02	5.66E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E-07‡	7.38E-07*	2.57E-06	4.00E-06	1.08E-05	1.90E-04
Lent. Nucl.	1.35E-02	1.34E-02	1.33E-02	1.33E-02	1.32E-02	1.34E-02	1.34E-02	1.33E-02	1.35E-02	1.33E-02	1.34E-02	1.32E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.53E-06*	3.67E-06*	1.11E-05	2.18E-05	3.54E-05	8.05E-05	4.95E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	8.03E-07‡	3.79E-07‡	2.66E-06*	1.67E-05	5.05E-05	1.11E-04	1.94E-04	8.90E-04	9.05E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.56E-07‡	9.63E-07†	1.37E-06*	7.01E-06	1.41E-05	4.45E-05	6.72E-04	4.11E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-07†	3.52E-07*	7.37E-07*	2.26E-06	3.06E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-07‡	1.52E-06*	5.34E-06	1.57E-05	1.98E-05	5.33E-05	6.01E-04
Thalami	1.15E-02	1.15E-02	1.15E-02	1.16E-02	1.15E-02	1.14E-02	1.14E-02	1.14E-02	1.14E-02	1.13E-02	1.13E-02	1.12E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.98E-09‡	2.21E-08‡	4.48E-08‡	4.96E-08†	7.39E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.87E-07‡	1.85E-06*	8.25E-06	1.31E-05	2.13E-05	5.13E-05
White Matter	4.44E-01	4.44E-01	4.45E-01	4.45E-01	4.44E-01	4.44E-01	4.44E-01	4.44E-01	4.42E-01	4.42E-01	4.40E-01	4.31E-01

Table A.30: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Caudate Nuclei.

	Photon Absorbed Fraction of Energy: φ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.98E-01	9.57E-01	7.02E-01	3.43E-01	1.96E-01	1.92E-01	1.94E-01	1.77E-01	1.61E-01	1.47E-01	1.10E-01
Caud. Nucl.	8.00E-01	4.94E-01	2.76E-01	1.02E-01	3.19E-02	1.85E-02	2.04E-02	2.16E-02	1.86E-02	1.52E-02	1.24E-02	5.94E-03
Cerebellum	0.00E+00	6.89E-05	1.88E-03	8.97E-03	8.85E-03	5.76E-03	5.30E-03	5.14E-03	4.78E-03	4.54E-03	4.10E-03	3.43E-03
Cereb. Cort.	1.20E-05*	6.78E-03	4.67E-02	9.72E-02	6.85E-02	4.14E-02	3.88E-02	3.85E-02	3.52E-02	3.24E-02	3.03E-02	2.46E-02
Cranium	0.00E+00	1.85E-03	2.55E-02	8.90E-02	7.15E-02	2.65E-02	1.59E-02	1.37E-02	1.25E-02	1.18E-02	1.09E-02	9.09E-03
Eyes	0.00E+00	2.00E-06‡	1.04E-04	8.43E-04	9.03E-04	6.98E-04	7.15E-04	7.31E-04	6.81E-04	6.24E-04	5.61E-04	4.69E-04
Lent. Nucl.	3.98E-02	7.69E-02	7.44E-02	4.19E-02	1.64E-02	9.01E-03	9.19E-03	9.55E-03	8.94E-03	8.04E-03	7.43E-03	5.10E-03
Mandible	0.00E+00	6.99E-06*	6.83E-04	7.85E-03	1.47E-02	8.70E-03	5.55E-03	4.79E-03	4.37E-03	4.23E-03	4.01E-03	3.33E-03
Other Tissues	0.00E+00	5.23E-05	2.82E-03	2.32E-02	3.29E-02	2.57E-02	2.49E-02	2.53E-02	2.37E-02	2.21E-02	2.07E-02	1.70E-02
Skin	0.00E+00	3.00E-06†	3.26E-04	2.40E-03	2.88E-03	2.31E-03	2.44E-03	2.56E-03	2.42E-03	2.18E-03	2.06E-03	1.67E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	3.82E-05	8.95E-05	7.58E-05	6.75E-05	6.12E-05	5.80E-05	5.13E-05	4.74E-05	4.33E-05
Spinal Skel.	0.00E+00	0.00E+00	7.30E-05	2.18E-03	5.31E-03	3.23E-03	1.92E-03	1.52E-03	1.32E-03	1.21E-03	1.16E-03	8.87E-04
Thalami	5.17E-03	2.08E-02	2.82E-02	2.09E-02	9.42E-03	5.14E-03	5.06E-03	5.13E-03	4.63E-03	4.24E-03	3.91E-03	3.07E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	9.74E-06*	2.40E-05	2.54E-05	2.57E-05	3.51E-05	3.27E-05	3.18E-05	2.57E-05	2.80E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.39E-04	1.06E-03	1.66E-03	1.93E-03	2.82E-03	3.42E-03	3.78E-03	3.80E-03	3.80E-03
White Matter	1.50E-01	3.69E-01	4.87E-01	4.00E-01	1.94E-01	1.09E-01	1.06E-01	1.07E-01	9.85E-02	9.02E-02	8.28E-02	6.39E-02

	Electron Absorbed Fraction of Energy: φ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.84E-01	9.35E-01	8.32E-01	7.21E-01	6.16E-01	3.25E-01
Cerebellum	0.00E+00	0.00E+00	0.00E+00	4.05E-08‡	8.15E-08‡	2.57E-06*	3.02E-06*	9.44E-06	2.78E-05	3.61E-05	5.03E-05	8.88E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.65E-07‡	2.69E-06*	1.29E-05	2.99E-05	1.02E-04	1.98E-04	2.92E-04	3.68E-04	1.56E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	1.32E-08‡	2.14E-06*	8.12E-06*	2.50E-05	6.42E-05	1.14E-04	1.57E-04	1.93E-04	3.10E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.64E-07†	2.14E-06	3.38E-06	4.50E-06	6.31E-06	1.05E-05
Lent. Nucl.	1.63E-05*	3.62E-05	6.18E-05	1.58E-04	3.35E-04	1.14E-03	3.57E-03	1.42E-02	3.45E-02	5.52E-02	7.27E-02	1.03E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-06†	4.58E-06	1.53E-05	2.75E-05	4.06E-05	6.04E-05	8.86E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.38E-07‡	3.95E-06*	1.30E-05	4.52E-05	1.06E-04	1.62E-04	2.23E-04	4.07E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E-08‡	9.74E-07*	4.28E-06	9.44E-06	1.60E-05	2.19E-05	4.03E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.83E-08‡	0.00E+00	6.56E-08†	2.91E-07*	2.18E-07*	4.93E-07*	1.60E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-06†	5.21E-06	1.04E-05	1.38E-05	1.73E-05	3.13E-05
Thalami	0.00E+00	0.00E+00	7.63E-07‡	6.40E-07‡	2.27E-06†	2.25E-06*	1.49E-05	3.75E-04	2.71E-03	7.13E-03	1.25E-02	3.18E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-07‡	2.05E-07‡	1.13E-07*	1.49E-07†	9.61E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.15E-07†	2.68E-06	8.54E-06	1.17E-05	2.44E-05	5.31E-05
White Matter	7.59E-05	1.58E-04	2.37E-04	4.56E-04	1.20E-03	4.06E-03	1.22E-02	4.93E-02	1.27E-01	2.06E-01	2.79E-01	4.77E-01

Table A.31: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Cerebellum.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.67E-01	8.90E-01	7.66E-01	5.03E-01	2.37E-01	1.39E-01	1.39E-01	1.43E-01	1.31E-01	1.18E-01	1.08E-01	8.02E-02
Caud. Nucl.	0.00E+00	4.00E-06†	1.30E-04	6.58E-04	6.37E-04	4.25E-04	3.83E-04	3.86E-04	3.39E-04	3.00E-04	2.87E-04	2.57E-04
Cerebellum	9.31E-01	7.84E-01	5.89E-01	2.98E-01	1.11E-01	6.29E-02	6.58E-02	6.88E-02	6.23E-02	5.52E-02	4.89E-02	3.28E-02
Cereb. Cort.	3.57E-02	9.43E-02	1.32E-01	1.21E-01	6.58E-02	3.90E-02	3.88E-02	3.96E-02	3.69E-02	3.39E-02	3.15E-02	2.50E-02
Cranium	2.18E-02	9.15E-02	1.64E-01	1.82E-01	9.37E-02	3.10E-02	2.06E-02	1.92E-02	1.79E-02	1.67E-02	1.53E-02	1.21E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	1.53E-05	8.09E-05	9.75E-05	1.03E-04	1.17E-04	1.26E-04	1.26E-04	1.12E-04	9.58E-05
Lent. Nucl.	0.00E+00	1.10E-05*	2.56E-04	1.24E-03	1.27E-03	8.25E-04	7.73E-04	7.15E-04	6.82E-04	6.04E-04	5.78E-04	4.48E-04
Mandible	0.00E+00	0.00E+00	2.05E-05	1.62E-03	5.76E-03	3.75E-03	2.56E-03	2.31E-03	2.25E-03	2.12E-03	2.01E-03	1.72E-03
Other Tissues	5.00E-06†	2.03E-03	1.46E-02	4.08E-02	4.04E-02	2.94E-02	2.97E-02	3.12E-02	2.96E-02	2.75E-02	2.57E-02	2.09E-02
Skin	2.00E-06‡	3.27E-04	2.17E-03	4.73E-03	3.70E-03	2.65E-03	2.90E-03	3.11E-03	2.86E-03	2.57E-03	2.35E-03	1.93E-03
Spinal Col.	0.00E+00	1.08E-05	7.53E-05	2.47E-04	2.75E-04	2.03E-04	2.03E-04	2.25E-04	2.32E-04	1.98E-04	1.66E-04	1.42E-04
Spinal Skel.	1.00E-06‡	2.68E-04	2.74E-03	1.34E-02	1.69E-02	7.98E-03	5.19E-03	4.73E-03	4.47E-03	4.11E-03	3.93E-03	3.04E-03
Thalami	0.00E+00	2.87E-05	6.37E-04	2.08E-03	1.81E-03	1.06E-03	9.93E-04	9.33E-04	8.25E-04	8.11E-04	7.78E-04	6.23E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	7.84E-06*	2.11E-05	2.63E-05	2.82E-05	3.90E-05	3.31E-05	3.60E-05	3.31E-05	2.55E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	9.71E-05	1.04E-03	2.02E-03	2.54E-03	3.79E-03	4.87E-03	5.27E-03	5.45E-03	5.43E-03
White Matter	1.09E-04	1.09E-02	4.30E-02	7.64E-02	5.43E-02	3.32E-02	3.12E-02	3.11E-02	2.91E-02	2.64E-02	2.50E-02	2.02E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.88E-01	9.70E-01	9.50E-01	9.30E-01	8.53E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E-07‡	9.34E-07†	1.83E-06	3.28E-06	3.25E-06	5.78E-06
Cerebellum	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.76E-01	9.41E-01	9.01E-01	8.62E-01	7.20E-01
Cereb. Cort.	1.05E-05	2.43E-05	5.03E-05	1.24E-04	3.01E-04	9.18E-04	2.93E-03	1.16E-02	2.92E-02	4.89E-02	6.74E-02	1.25E-01
Cranium	0.00E+00	0.00E+00	6.38E-07‡	1.14E-06‡	5.79E-06†	2.28E-05	5.03E-05	1.48E-03	1.41E-02	3.09E-02	4.63E-02	7.35E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.74E-08‡	1.65E-07*	3.06E-07*	9.03E-07	2.22E-06*
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.63E-09‡	6.46E-07‡	2.64E-06	4.16E-06	5.92E-06	6.89E-06	1.05E-05
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.14E-07‡	2.10E-06*	7.33E-06	1.09E-05	1.79E-05	2.21E-05	4.66E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-06†	3.87E-06*	1.82E-05	5.98E-05	1.32E-04	2.36E-04	1.51E-03	1.97E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.07E-07‡	2.45E-06*	6.01E-06	1.39E-05	3.14E-05	3.70E-04	3.26E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.11E-09‡	3.56E-07*	1.07E-06	7.16E-07	5.23E-06	7.44E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-08‡	2.42E-06*	6.14E-06	1.63E-05	2.81E-05	4.40E-05	1.65E-04	2.03E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.37E-09‡	1.26E-06	1.70E-06	4.41E-06	7.84E-06	9.22E-06	1.44E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.53E-09‡	1.16E-07‡	8.44E-08†	3.61E-07‡	6.12E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E-06‡	3.91E-06	9.06E-06	1.87E-05	2.52E-05	7.35E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	6.05E-07‡	3.31E-06†	1.05E-05	2.25E-05	7.70E-05	1.57E-04	2.31E-04	3.10E-04	8.95E-03

Table A.32: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Cerebral Cortex.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.45E-01	8.37E-01	7.08E-01	4.66E-01	2.23E-01	1.32E-01	1.33E-01	1.37E-01	1.26E-01	1.13E-01	1.03E-01	7.67E-02
Caud. Nucl.	1.00E-06‡	1.26E-04	8.01E-04	1.76E-03	1.28E-03	7.64E-04	7.00E-04	7.19E-04	6.22E-04	5.67E-04	5.49E-04	4.64E-04
Cerebellum	9.01E-03	2.38E-02	3.30E-02	3.05E-02	1.66E-02	9.98E-03	9.73E-03	1.01E-02	9.35E-03	8.53E-03	7.89E-03	6.29E-03
Cereb. Cort.	8.84E-01	6.74E-01	4.79E-01	2.52E-01	1.06E-01	6.25E-02	6.55E-02	6.82E-02	6.22E-02	5.50E-02	4.92E-02	3.43E-02
Cranium	3.61E-02	1.34E-01	2.05E-01	1.98E-01	9.65E-02	3.14E-02	2.14E-02	2.06E-02	1.91E-02	1.76E-02	1.65E-02	1.26E-02
Eyes	0.00E+00	3.30E-05	1.90E-04	5.46E-04	5.86E-04	4.69E-04	4.86E-04	5.11E-04	4.91E-04	4.26E-04	4.38E-04	3.44E-04
Lent. Nucl.	2.80E-05	6.94E-04	2.13E-03	3.36E-03	2.30E-03	1.41E-03	1.28E-03	1.25E-03	1.16E-03	1.08E-03	9.78E-04	8.26E-04
Mandible	0.00E+00	1.72E-04	1.38E-03	6.54E-03	1.02E-02	5.84E-03	3.86E-03	3.56E-03	3.35E-03	3.14E-03	3.02E-03	2.54E-03
Other Tissues	1.15E-05	1.71E-03	1.02E-02	2.79E-02	2.89E-02	2.22E-02	2.23E-02	2.32E-02	2.22E-02	2.05E-02	1.93E-02	1.58E-02
Skin	3.00E-06†	7.43E-04	3.15E-03	5.67E-03	4.09E-03	2.98E-03	3.27E-03	3.61E-03	3.27E-03	2.92E-03	2.64E-03	2.11E-03
Spinal Col.	0.00E+00	1.10E-05†	3.07E-05	8.99E-05	1.09E-04	9.72E-05	9.59E-05	8.47E-05	8.36E-05	9.10E-05	7.35E-05	6.39E-05
Spinal Skel.	0.00E+00	1.16E-04	1.04E-03	4.94E-03	6.90E-03	3.60E-03	2.30E-03	2.06E-03	1.85E-03	1.69E-03	1.59E-03	1.33E-03
Thalami	6.00E-06†	2.74E-04	1.49E-03	2.87E-03	2.00E-03	1.23E-03	1.10E-03	1.08E-03	1.01E-03	9.27E-04	8.48E-04	7.03E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	5.55E-06*	1.59E-05	2.17E-05	1.89E-05	2.15E-05	2.80E-05	3.17E-05	2.23E-05	2.08E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.37E-04	8.28E-04	1.39E-03	1.72E-03	2.46E-03	3.06E-03	3.39E-03	3.52E-03	3.57E-03
White Matter	5.19E-02	1.37E-01	1.88E-01	1.70E-01	9.18E-02	5.39E-02	5.29E-02	5.36E-02	5.01E-02	4.54E-02	4.22E-02	3.30E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.95E-01	9.82E-01	9.53E-01	9.22E-01	8.90E-01	7.82E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.62E-07‡	2.81E-07*	1.11E-06	4.34E-06	5.23E-06	7.86E-06	2.68E-05
Cerebellum	5.53E-06*	1.05E-05*	1.06E-05	3.24E-05	6.47E-05	2.29E-04	7.51E-04	2.86E-03	7.33E-03	1.24E-02	1.69E-02	3.13E-02
Cereb. Cort.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.91E-01	9.63E-01	9.03E-01	8.39E-01	7.74E-01	5.66E-01
Cranium	0.00E+00	0.00E+00	1.43E-06‡	1.90E-06†	8.12E-06	2.57E-05	5.44E-05	2.63E-03	2.36E-02	5.08E-02	7.51E-02	1.08E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E-08‡	1.47E-08‡	6.45E-07	3.27E-06	5.38E-06	1.60E-05	4.19E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.69E-07*	6.95E-07*	2.79E-06	6.71E-06	1.65E-05	6.21E-05	8.21E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-06†	3.38E-06*	9.87E-06	2.08E-05	4.01E-05	1.33E-04	1.04E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	3.04E-07‡	4.70E-07‡	2.01E-06†	1.24E-05	4.54E-05	9.96E-05	2.52E-04	1.51E-03	1.64E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.76E-07‡	1.96E-06*	5.81E-06	1.71E-05	6.84E-05	1.50E-03	8.92E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.67E-08‡	4.52E-08‡	1.25E-07‡	8.57E-08†	6.39E-07*	4.27E-06*	4.79E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-07‡	1.05E-06*	7.70E-06	1.35E-05	2.17E-05	6.74E-05	7.77E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-07‡	1.24E-06	2.65E-06	5.93E-06	8.21E-06	1.01E-05	1.35E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-08‡	1.56E-07‡	2.74E-07‡	9.54E-08†	7.42E-07†
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.07E-07‡	3.60E-06	5.52E-06	1.37E-05	1.74E-05	4.69E-05
White Matter	2.10E-05	4.34E-05	7.96E-05	1.53E-04	3.90E-04	1.32E-03	4.14E-03	1.63E-02	4.25E-02	7.03E-02	9.82E-02	1.81E-01

Table A.33: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Cranial CSF.

Photon Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.44E-01	4.02E-01	3.87E-01	2.90E-01	1.53E-01	9.34E-02	9.45E-02	9.82E-02	9.16E-02	8.38E-02	7.67E-02	5.94E-02
Caud. Nucl.	0.00E+00	3.89E-05	4.17E-04	1.06E-03	8.79E-04	5.62E-04	5.25E-04	5.32E-04	4.93E-04	4.38E-04	4.08E-04	3.26E-04
Cerebellum	4.72E-02	5.42E-02	4.97E-02	3.43E-02	1.70E-02	1.03E-02	1.05E-02	1.10E-02	1.01E-02	9.37E-03	8.34E-03	6.56E-03
Cereb. Cort.	2.96E-01	3.15E-01	2.58E-01	1.54E-01	7.11E-02	4.31E-02	4.51E-02	4.74E-02	4.44E-02	4.02E-02	3.68E-02	2.67E-02
Cranium	3.64E-01	4.55E-01	4.44E-01	3.14E-01	1.30E-01	4.11E-02	2.99E-02	2.99E-02	2.77E-02	2.49E-02	2.19E-02	1.46E-02
Eyes	0.00E+00	4.40E-05	2.37E-04	5.51E-04	6.23E-04	4.81E-04	5.29E-04	5.11E-04	5.23E-04	4.59E-04	4.38E-04	3.73E-04
Lent. Nucl.	2.00E-06‡	2.88E-04	1.27E-03	2.26E-03	1.67E-03	1.04E-03	1.00E-03	9.89E-04	9.70E-04	8.36E-04	7.75E-04	6.33E-04
Mandible	2.00E-06‡	3.17E-04	1.90E-03	7.44E-03	1.08E-02	6.02E-03	4.06E-03	3.83E-03	3.68E-03	3.34E-03	3.24E-03	2.66E-03
Other Tissues	3.21E-05	4.29E-03	1.73E-02	3.58E-02	3.34E-02	2.52E-02	2.58E-02	2.75E-02	2.63E-02	2.44E-02	2.28E-02	1.84E-02
Skin	1.60E-05	1.62E-03	4.92E-03	6.92E-03	4.70E-03	3.45E-03	3.87E-03	4.24E-03	3.90E-03	3.56E-03	3.15E-03	2.34E-03
Spinal Col.	0.00E+00	1.12E-05*	4.33E-05	1.24E-04	1.21E-04	1.12E-04	1.17E-04	1.11E-04	1.02E-04	1.10E-04	9.67E-05	8.26E-05
Spinal Skel.	3.00E-06‡	2.91E-04	1.99E-03	6.96E-03	8.69E-03	4.17E-03	2.79E-03	2.63E-03	2.37E-03	2.17E-03	2.06E-03	1.63E-03
Thalami	0.00E+00	1.32E-04	7.46E-04	1.78E-03	1.44E-03	8.75E-04	8.37E-04	8.35E-04	7.55E-04	7.32E-04	6.62E-04	5.35E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	8.48E-06*	2.43E-05	2.37E-05	2.57E-05	2.46E-05	2.73E-05	3.36E-05	2.71E-05	2.60E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.28E-04	9.21E-04	1.46E-03	1.71E-03	2.54E-03	3.06E-03	3.36E-03	3.45E-03	3.41E-03
White Matter	1.04E-03	3.21E-02	7.62E-02	9.47E-02	5.93E-02	3.64E-02	3.56E-02	3.65E-02	3.40E-02	3.14E-02	2.89E-02	2.39E-02

Electron Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.98E-04	8.21E-04	1.46E-03	2.96E-03	7.54E-03	2.46E-02	7.72E-02	2.66E-01	3.77E-01	4.11E-01	4.24E-01	4.32E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.52E-07†	1.57E-06*	2.37E-06	3.83E-06	5.55E-06	9.68E-06
Cerebellum	5.42E-05	1.19E-04	2.04E-04	4.22E-04	1.08E-03	3.32E-03	1.05E-02	3.67E-02	5.23E-02	5.62E-02	5.79E-02	5.78E-02
Cereb. Cort.	3.44E-04	7.02E-04	1.26E-03	2.54E-03	6.46E-03	2.12E-02	6.67E-02	2.29E-01	3.25E-01	3.54E-01	3.65E-01	3.25E-01
Cranium	3.98E-04	8.51E-04	1.41E-03	2.98E-03	7.29E-03	2.46E-02	7.68E-02	2.65E-01	3.82E-01	4.13E-01	3.85E-01	2.57E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.33E-08‡	6.20E-07†	1.77E-06	1.74E-06	1.85E-05	1.28E-04	8.81E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.97E-07†	4.94E-07†	2.33E-06	4.45E-06	7.93E-06	1.13E-05	2.40E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.81E-07‡	1.11E-06†	2.89E-06	1.09E-05	2.27E-05	2.52E-04	6.97E-04	2.53E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.06E-07‡	6.74E-06*	1.70E-05	5.73E-05	1.30E-04	2.83E-03	1.71E-02	5.19E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.08E-07‡	3.76E-06	7.90E-06	2.08E-05	2.91E-03	1.58E-02	2.05E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.39E-09‡	1.95E-07†	4.42E-07†	7.60E-06	5.45E-05	1.95E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.74E-07‡	1.12E-06‡	1.77E-06†	9.60E-06	1.72E-05	1.10E-04	9.05E-04	3.46E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.82E-07‡	9.37E-07†	1.52E-06	4.52E-06	7.00E-06	8.24E-06	2.09E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E-08‡	1.06E-07†	9.18E-08†	7.25E-08*	3.03E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E-06	6.57E-06	1.46E-05	1.87E-05	4.10E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	4.89E-07‡	2.53E-06*	9.30E-06	3.47E-05	9.15E-05	2.03E-04	2.91E-04	1.08E-03	4.81E-02

Table A.34: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Cranium.

Photon Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	2.35E-02	9.38E-02	1.68E-01	2.00E-01	1.27E-01	8.11E-02	8.27E-02	8.63E-02	8.10E-02	7.47E-02	6.95E-02	5.49E-02
Caud. Nucl.	0.00E+00	1.49E-05	2.54E-04	8.93E-04	7.80E-04	5.26E-04	4.84E-04	4.75E-04	4.47E-04	4.00E-04	3.76E-04	3.14E-04
Cerebellum	3.12E-03	1.24E-02	2.10E-02	2.35E-02	1.37E-02	8.78E-03	9.00E-03	9.54E-03	9.02E-03	8.23E-03	7.76E-03	5.95E-03
Cereb. Cort.	2.02E-02	7.09E-02	1.05E-01	1.00E-01	5.71E-02	3.62E-02	3.81E-02	4.02E-02	3.79E-02	3.48E-02	3.22E-02	2.49E-02
Cranium	9.23E-01	7.68E-01	5.90E-01	3.49E-01	1.40E-01	4.45E-02	3.37E-02	3.38E-02	3.03E-02	2.61E-02	2.26E-02	1.48E-02
Eyes	7.00E-06*	1.18E-04	3.59E-04	6.07E-04	5.65E-04	4.87E-04	5.05E-04	5.51E-04	5.21E-04	4.73E-04	4.64E-04	3.70E-04
Lent. Nucl.	1.00E-06‡	1.22E-04	6.85E-04	1.72E-03	1.55E-03	9.98E-04	9.22E-04	9.18E-04	8.58E-04	7.93E-04	7.29E-04	5.93E-04
Mandible	3.80E-04	1.67E-03	3.87E-03	8.75E-03	1.08E-02	6.15E-03	4.13E-03	3.81E-03	3.75E-03	3.47E-03	3.33E-03	2.71E-03
Other Tissues	1.15E-02	2.73E-02	3.90E-02	4.38E-02	3.47E-02	2.60E-02	2.69E-02	2.87E-02	2.72E-02	2.55E-02	2.36E-02	1.84E-02
Skin	1.12E-02	1.41E-02	1.33E-02	9.68E-03	5.38E-03	3.95E-03	4.41E-03	4.91E-03	4.46E-03	3.86E-03	3.44E-03	2.37E-03
Spinal Col.	3.59E-05	9.03E-05	1.11E-04	1.41E-04	1.20E-04	1.16E-04	1.21E-04	1.24E-04	1.22E-04	1.11E-04	1.00E-04	9.37E-05
Spinal Skel.	7.24E-04	2.30E-03	4.60E-03	8.70E-03	9.15E-03	4.39E-03	2.89E-03	2.60E-03	2.53E-03	2.34E-03	2.10E-03	1.71E-03
Thalami	0.00E+00	4.99E-05	4.27E-04	1.37E-03	1.25E-03	8.12E-04	7.77E-04	7.58E-04	7.01E-04	6.40E-04	5.93E-04	5.07E-04
Thyroid	0.00E+00	0.00E+00	1.00E-06‡	7.58E-06	2.29E-05	2.33E-05	2.29E-05	2.40E-05	2.58E-05	3.34E-05	3.18E-05	2.25E-05
Trunk	0.00E+00	0.00E+00	1.98E-06‡	1.46E-04	9.35E-04	1.38E-03	1.74E-03	2.48E-03	3.00E-03	3.36E-03	3.34E-03	3.43E-03
White Matter	1.35E-04	1.03E-02	4.03E-02	7.08E-02	5.13E-02	3.28E-02	3.25E-02	3.35E-02	3.12E-02	2.91E-02	2.70E-02	2.20E-02

Electron Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	2.42E-07‡	2.95E-06†	8.51E-06	3.74E-05	8.92E-05	5.83E-03	5.31E-02	1.15E-01	1.71E-01	2.75E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E-07‡	8.66E-07	2.58E-06	3.73E-06	4.87E-06	8.84E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-06†	4.98E-06	1.12E-05	7.04E-04	6.98E-03	1.53E-02	2.28E-02	3.64E-02
Cereb. Cort.	0.00E+00	0.00E+00	2.42E-07‡	2.95E-06†	5.26E-06*	1.92E-05	4.48E-05	5.02E-03	4.59E-02	9.94E-02	1.48E-01	2.13E-01
Cranium	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.79E-01	9.19E-01	7.90E-01	6.50E-01	5.33E-01	3.16E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-07‡	7.80E-07‡	2.03E-06†	4.05E-05	1.73E-04	3.93E-04	1.20E-03
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.36E-07‡	1.08E-06*	2.56E-06	5.90E-06	8.50E-06	1.03E-05	1.02E-04
Mandible	0.00E+00	8.31E-07‡	2.34E-06‡	4.92E-06*	8.77E-06	3.03E-05	8.63E-05	3.68E-04	9.11E-04	1.55E-03	2.27E-03	4.03E-03
Other Tissues	2.15E-05	4.29E-05	7.44E-05	1.26E-04	3.46E-04	1.11E-03	3.51E-03	1.31E-02	3.18E-02	5.03E-02	6.38E-02	7.89E-02
Skin	2.07E-05	5.45E-05	1.03E-04	2.34E-04	4.92E-04	1.86E-03	5.69E-03	2.25E-02	3.90E-02	4.41E-02	4.27E-02	3.08E-02
Spinal Col.	9.11E-07‡	0.00E+00	0.00E+00	4.18E-07‡	0.00E+00	3.65E-06‡	1.06E-05	4.23E-05	1.00E-04	1.71E-04	2.27E-04	3.07E-04
Spinal Skel.	0.00E+00	2.96E-06†	2.34E-06†	5.00E-06*	1.31E-05	6.61E-05	1.67E-04	6.31E-04	1.75E-03	2.84E-03	3.89E-03	5.51E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.04E-07†	2.67E-06	4.34E-06	8.58E-06	7.07E-06	1.49E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E-08‡	8.59E-08‡	1.13E-07*	5.68E-07‡	2.08E-07†	2.50E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-06†	3.00E-06	7.18E-06	1.74E-05	2.28E-05	4.35E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.12E-06*	1.20E-05	3.06E-05	9.54E-05	2.10E-04	2.82E-04	4.67E-04	2.53E-02

Table A.35: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Lateral Ventricles.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	9.77E-01	7.46E-01	3.71E-01	2.11E-01	2.05E-01	2.06E-01	1.89E-01	1.71E-01	1.55E-01	1.18E-01
Caud. Nucl.	2.37E-03	1.53E-02	2.11E-02	1.55E-02	6.68E-03	3.63E-03	3.59E-03	3.66E-03	3.35E-03	3.12E-03	2.91E-03	2.17E-03
Cerebellum	0.00E+00	9.73E-04	7.98E-03	2.01E-02	1.57E-02	9.37E-03	8.60E-03	8.45E-03	7.88E-03	7.20E-03	6.75E-03	5.45E-03
Cereb. Cort.	4.41E-03	4.05E-02	9.62E-02	1.36E-01	8.58E-02	5.00E-02	4.75E-02	4.73E-02	4.36E-02	4.00E-02	3.71E-02	2.99E-02
Cranium	0.00E+00	2.53E-04	1.40E-02	7.57E-02	6.80E-02	2.57E-02	1.52E-02	1.31E-02	1.20E-02	1.11E-02	1.05E-02	8.62E-03
Eyes	0.00E+00	0.00E+00	2.00E-05	3.29E-04	5.14E-04	4.06E-04	4.26E-04	4.17E-04	4.22E-04	3.69E-04	3.30E-04	2.81E-04
Lent. Nucl.	1.04E-03	8.59E-03	1.70E-02	1.64E-02	8.16E-03	4.48E-03	4.30E-03	4.27E-03	3.98E-03	3.53E-03	3.31E-03	2.61E-03
Mandible	0.00E+00	1.00E-06‡	1.98E-04	4.45E-03	1.04E-02	6.51E-03	4.23E-03	3.66E-03	3.35E-03	3.19E-03	3.01E-03	2.53E-03
Other Tissues	0.00E+00	7.60E-06*	1.34E-03	1.77E-02	2.85E-02	2.25E-02	2.18E-02	2.22E-02	2.08E-02	1.95E-02	1.82E-02	1.49E-02
Skin	0.00E+00	1.96E-06‡	2.83E-04	2.29E-03	2.98E-03	2.27E-03	2.37E-03	2.53E-03	2.38E-03	2.13E-03	1.99E-03	1.64E-03
Spinal Col.	0.00E+00	0.00E+00	4.98E-06†	5.01E-05	1.04E-04	8.91E-05	8.32E-05	8.66E-05	8.71E-05	7.82E-05	7.59E-05	5.44E-05
Spinal Skel.	0.00E+00	0.00E+00	1.33E-04	2.79E-03	6.38E-03	3.73E-03	2.22E-03	1.83E-03	1.62E-03	1.51E-03	1.43E-03	1.19E-03
Thalami	1.88E-03	1.29E-02	2.33E-02	2.02E-02	9.17E-03	5.05E-03	4.97E-03	4.82E-03	4.54E-03	4.11E-03	3.77E-03	3.00E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	7.99E-06	2.72E-05	2.56E-05	2.22E-05	3.20E-05	2.91E-05	3.21E-05	2.07E-05	2.57E-05
Trunk	0.00E+00	0.00E+00	1.00E-06‡	1.37E-04	1.04E-03	1.66E-03	2.03E-03	3.02E-03	3.83E-03	4.16E-03	4.60E-03	4.56E-03
White Matter	1.48E-01	3.36E-01	4.47E-01	3.88E-01	1.95E-01	1.09E-01	1.05E-01	1.06E-01	9.74E-02	8.86E-02	8.12E-02	6.31E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.84E-07‡	3.20E-06*	4.63E-06	1.44E-05	2.98E-04	2.58E-03	6.86E-03	2.52E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-06‡	1.82E-06*	7.53E-06	2.10E-05	4.26E-05	6.54E-05	8.48E-05	1.99E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	1.88E-06†	5.91E-06*	1.70E-05	4.17E-05	1.31E-04	9.61E-04	4.86E-03	1.15E-02	5.64E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.85E-07‡	5.93E-06	2.34E-05	5.98E-05	1.08E-04	1.55E-04	1.82E-04	2.82E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.38E-08‡	5.03E-07‡	4.63E-07*	1.49E-06	3.56E-06	2.99E-06	6.49E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	7.96E-07‡	1.50E-06†	1.41E-06*	4.77E-06	1.30E-05	2.69E-04	1.37E-03	2.99E-03	1.08E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.53E-07‡	2.46E-06*	8.62E-06	2.17E-05	3.24E-05	3.65E-05	6.84E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E-06†	3.07E-06*	1.19E-05	4.19E-05	9.95E-05	1.42E-04	1.92E-04	3.69E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.92E-07‡	1.84E-06*	4.77E-06	9.60E-06	1.70E-05	2.02E-05	3.80E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-08‡	2.33E-08‡	2.75E-07‡	3.84E-07*	6.17E-07*	1.54E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.52E-07‡	8.26E-07‡	2.61E-06	7.13E-06	1.37E-05	1.67E-05	2.18E-05	3.91E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.41E-08‡	2.53E-06*	6.14E-06	5.94E-05	6.98E-04	2.34E-03	4.55E-03	1.74E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.73E-08‡	2.72E-07†	2.74E-07*	5.01E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.83E-07‡	4.33E-07†	2.34E-06*	6.82E-06	1.26E-05	2.65E-05	5.67E-05
White Matter	5.79E-05	1.34E-04	2.55E-04	5.11E-04	1.19E-03	4.06E-03	1.27E-02	5.05E-02	1.28E-01	2.04E-01	2.69E-01	4.29E-01

Table A.36: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Lentiform Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.92E-01	9.31E-01	6.69E-01	3.29E-01	1.90E-01	1.86E-01	1.87E-01	1.70E-01	1.54E-01	1.40E-01	1.06E-01
Caud. Nucl.	2.22E-02	4.27E-02	4.11E-02	2.33E-02	9.15E-03	5.00E-03	5.16E-03	5.27E-03	4.89E-03	4.52E-03	3.98E-03	2.81E-03
Cerebellum	0.00E+00	5.59E-05	1.95E-03	9.70E-03	9.60E-03	6.24E-03	5.69E-03	5.55E-03	5.13E-03	4.78E-03	4.46E-03	3.65E-03
Cereb. Cort.	8.54E-04	2.09E-02	6.43E-02	1.00E-01	6.81E-02	4.12E-02	3.89E-02	3.84E-02	3.54E-02	3.25E-02	3.01E-02	2.46E-02
Cranium	2.20E-05*	6.62E-03	4.22E-02	1.04E-01	7.68E-02	2.84E-02	1.69E-02	1.45E-02	1.34E-02	1.23E-02	1.15E-02	9.49E-03
Eyes	0.00E+00	0.00E+00	4.57E-05	4.89E-04	8.26E-04	6.64E-04	6.62E-04	6.81E-04	6.20E-04	6.06E-04	5.57E-04	4.33E-04
Lent. Nucl.	8.37E-01	5.75E-01	3.50E-01	1.39E-01	4.54E-02	2.61E-02	2.82E-02	2.99E-02	2.62E-02	2.21E-02	1.85E-02	1.02E-02
Mandible	0.00E+00	6.58E-05	2.19E-03	1.59E-02	2.37E-02	1.26E-02	7.86E-03	6.82E-03	6.38E-03	5.84E-03	5.45E-03	4.55E-03
Other Tissues	0.00E+00	5.86E-04	9.97E-03	4.46E-02	5.06E-02	3.76E-02	3.57E-02	3.57E-02	3.34E-02	3.08E-02	2.86E-02	2.34E-02
Skin	0.00E+00	2.00E-06‡	2.23E-04	1.91E-03	2.73E-03	2.26E-03	2.36E-03	2.50E-03	2.36E-03	2.08E-03	1.99E-03	1.61E-03
Spinal Col.	0.00E+00	0.00E+00	1.95E-06‡	6.06E-05	1.18E-04	9.40E-05	9.20E-05	8.19E-05	8.27E-05	6.57E-05	6.55E-05	5.05E-05
Spinal Skel.	0.00E+00	0.00E+00	2.00E-04	3.85E-03	8.05E-03	4.56E-03	2.63E-03	1.98E-03	1.78E-03	1.60E-03	1.51E-03	1.24E-03
Thalami	3.33E-02	6.76E-02	6.86E-02	4.07E-02	1.56E-02	8.75E-03	8.85E-03	9.20E-03	8.31E-03	7.59E-03	6.95E-03	4.95E-03
Thyroid	0.00E+00	0.00E+00	1.00E-06‡	3.13E-05	5.22E-05	3.68E-05	3.70E-05	4.62E-05	4.70E-05	3.59E-05	4.04E-05	3.09E-05
Trunk	0.00E+00	0.00E+00	2.99E-06†	2.60E-04	1.71E-03	2.38E-03	2.73E-03	3.76E-03	4.52E-03	4.81E-03	5.00E-03	4.91E-03
White Matter	1.06E-01	2.76E-01	3.84E-01	3.36E-01	1.71E-01	9.71E-02	9.37E-02	9.34E-02	8.59E-02	7.85E-02	7.23E-02	5.64E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.84E-01
Caud. Nucl.	9.29E-06	2.43E-05	4.16E-05	6.92E-05	1.92E-04	6.10E-04	1.96E-03	7.72E-03	1.93E-02	3.06E-02	4.04E-02	5.69E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.23E-07‡	3.67E-06	1.35E-05	2.59E-05	4.07E-05	5.59E-05	9.66E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E-06*	1.71E-05	2.74E-05	9.96E-05	2.10E-04	4.63E-04	1.90E-03	2.46E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	7.87E-07‡	5.83E-06*	1.29E-05	3.14E-05	7.67E-05	1.30E-04	1.72E-04	2.18E-04	1.71E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.31E-07*	1.27E-06	3.19E-06	4.90E-06	5.74E-06	1.17E-05
Lent. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.95E-01	9.86E-01	9.44E-01	8.59E-01	7.72E-01	6.91E-01	4.42E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.30E-07‡	3.79E-06	8.24E-06	2.27E-05	4.54E-05	5.93E-05	7.90E-05	1.35E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-06‡	8.45E-06	1.98E-05	6.81E-05	1.63E-04	2.47E-04	3.24E-04	7.47E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.94E-08‡	1.45E-06*	4.80E-06	9.64E-06	1.54E-05	2.11E-05	4.02E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.76E-07†	2.95E-07*	4.20E-07*	5.42E-07	1.26E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.84E-07‡	3.04E-06*	8.56E-06	1.67E-05	1.96E-05	2.57E-05	3.91E-05
Thalami	1.85E-05	2.69E-05	6.73E-05	1.12E-04	2.85E-04	9.86E-04	3.01E-03	1.17E-02	2.88E-02	4.57E-02	6.03E-02	9.08E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.60E-07†	9.99E-08*	2.52E-07*	4.99E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.43E-07†	3.37E-06	1.28E-05	1.87E-05	3.09E-05	6.43E-05
White Matter	4.00E-05	1.14E-04	1.89E-04	3.46E-04	8.92E-04	2.86E-03	8.98E-03	3.52E-02	8.89E-02	1.44E-01	1.96E-01	3.57E-01

Table A.37: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Spinal CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E-06‡	7.06E-04	5.24E-03	2.06E-02	3.18E-02	2.76E-02	2.73E-02	2.80E-02	2.65E-02	2.47E-02	2.34E-02	1.93E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	7.80E-05	1.62E-04	1.78E-04	1.57E-04	1.75E-04	1.49E-04	1.41E-04	1.40E-04	1.15E-04
Cerebellum	0.00E+00	2.05E-04	1.48E-03	5.17E-03	6.49E-03	5.15E-03	5.11E-03	5.26E-03	4.95E-03	4.55E-03	4.36E-03	3.49E-03
Cereb. Cort.	1.00E-06‡	4.42E-04	2.67E-03	8.09E-03	1.15E-02	1.01E-02	1.01E-02	1.05E-02	9.99E-03	9.40E-03	8.81E-03	7.40E-03
Cranium	5.39E-03	1.34E-02	1.88E-02	2.41E-02	2.40E-02	1.15E-02	7.58E-03	6.87E-03	6.32E-03	5.98E-03	5.53E-03	4.50E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	3.02E-06†	3.96E-05	8.20E-05	9.42E-05	1.01E-04	1.00E-04	1.05E-04	1.07E-04	9.34E-05
Lent. Nucl.	0.00E+00	0.00E+00	6.89E-06*	2.23E-04	4.96E-04	4.31E-04	4.42E-04	4.06E-04	3.69E-04	3.57E-04	3.26E-04	2.61E-04
Mandible	0.00E+00	0.00E+00	5.25E-05	3.67E-03	1.22E-02	7.94E-03	5.16E-03	4.53E-03	4.22E-03	3.99E-03	3.72E-03	3.10E-03
Other Tissues	0.00E+00	1.18E-04	8.42E-03	7.74E-02	9.95E-02	7.65E-02	7.70E-02	7.92E-02	7.43E-02	6.89E-02	6.42E-02	5.24E-02
Skin	0.00E+00	1.04E-06‡	1.60E-04	1.71E-03	2.51E-03	2.17E-03	2.43E-03	2.56E-03	2.39E-03	2.18E-03	1.99E-03	1.62E-03
Spinal Col.	9.22E-02	1.16E-01	8.06E-02	3.34E-02	1.13E-02	6.71E-03	7.29E-03	7.68E-03	7.20E-03	6.35E-03	5.57E-03	3.15E-03
Spinal Skel.	1.86E-01	4.36E-01	6.20E-01	6.02E-01	2.90E-01	9.39E-02	6.64E-02	6.38E-02	5.88E-02	5.34E-02	4.91E-02	3.66E-02
Thalami	0.00E+00	0.00E+00	3.30E-05	3.50E-04	6.29E-04	5.40E-04	5.10E-04	4.97E-04	4.61E-04	4.17E-04	4.13E-04	3.26E-04
Thyroid	0.00E+00	1.00E-06‡	7.54E-05	5.18E-04	5.71E-04	4.00E-04	4.15E-04	3.94E-04	3.75E-04	3.64E-04	3.16E-04	2.71E-04
Trunk	5.07E-03	1.36E-02	2.31E-02	4.20E-02	5.37E-02	4.56E-02	4.66E-02	5.08E-02	5.10E-02	4.93E-02	4.71E-02	4.07E-02
White Matter	0.00E+00	5.91E-05	1.03E-03	6.54E-03	1.21E-02	1.09E-02	1.05E-02	1.08E-02	1.03E-02	9.45E-03	9.01E-03	7.44E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.83E-07‡	4.83E-06*	1.36E-05	5.28E-05	1.14E-04	1.94E-04	6.39E-04	7.29E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.10E-07†	8.81E-07*	1.01E-06	2.00E-06*	2.68E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-06*	3.41E-06	1.05E-05	2.22E-05	4.02E-05	1.91E-04	2.04E-03
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.12E-08‡	1.91E-06†	4.81E-06	1.96E-05	4.21E-05	7.32E-05	3.37E-04	5.00E-03
Cranium	2.47E-06†	4.06E-06*	7.41E-06*	1.67E-05	4.67E-05	1.56E-04	4.55E-04	1.82E-03	4.71E-03	7.69E-03	1.01E-02	1.37E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.93E-08‡	4.48E-07†	6.34E-07*	8.13E-07*	1.72E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.30E-07‡	2.11E-07‡	8.17E-07	1.63E-06	2.11E-06	5.11E-06	5.94E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.65E-07†	2.99E-06	1.33E-05	2.91E-05	4.14E-05	4.77E-05	9.78E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-06*	1.19E-05*	3.81E-05	1.58E-04	3.55E-04	5.49E-04	7.30E-04	7.35E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-06*	4.69E-06	1.16E-05	1.85E-05	2.40E-05	4.80E-05
Spinal Col.	4.47E-05	8.95E-05	1.75E-04	3.31E-04	8.58E-04	2.77E-03	8.59E-03	3.41E-02	8.80E-02	1.38E-01	1.61E-01	1.15E-01
Spinal Skel.	7.06E-05	1.80E-04	3.10E-04	6.23E-04	1.42E-03	4.93E-03	1.52E-02	6.07E-02	1.58E-01	2.56E-01	3.30E-01	5.15E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.53E-08‡	0.00E+00	9.50E-07	2.24E-06	2.52E-06	5.04E-06	9.40E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-07‡	8.21E-07†	1.77E-06	1.22E-06	3.45E-06	4.38E-06
Trunk	1.27E-06‡	7.15E-06*	8.24E-06	1.51E-05	3.96E-05	1.28E-04	4.63E-04	1.83E-03	4.75E-03	7.87E-03	1.10E-02	2.27E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.42E-07‡	7.13E-07†	5.18E-06	2.02E-05	4.28E-05	7.27E-05	9.62E-05	2.27E-04

Table A.38: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Spinal Skeleton.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	2.32E-04	2.52E-03	1.61E-02	2.94E-02	2.68E-02	2.67E-02	2.75E-02	2.62E-02	2.42E-02	2.29E-02	1.91E-02
Caud. Nucl.	0.00E+00	0.00E+00	1.11E-06‡	5.72E-05	1.48E-04	1.74E-04	1.72E-04	1.72E-04	1.63E-04	1.45E-04	1.26E-04	1.16E-04
Cerebellum	0.00E+00	7.90E-05	7.69E-04	3.90E-03	5.92E-03	5.04E-03	5.09E-03	5.28E-03	4.85E-03	4.58E-03	4.33E-03	3.57E-03
Cereb. Cort.	0.00E+00	1.34E-04	1.18E-03	6.23E-03	1.05E-02	9.72E-03	9.85E-03	1.02E-02	9.86E-03	9.10E-03	8.74E-03	7.22E-03
Cranium	1.48E-03	4.84E-03	9.91E-03	2.01E-02	2.31E-02	1.14E-02	7.36E-03	6.63E-03	6.32E-03	5.93E-03	5.51E-03	4.51E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	2.02E-06‡	4.52E-05	7.89E-05	8.50E-05	9.93E-05	1.04E-04	1.02E-04	9.35E-05	8.83E-05
Lent. Nucl.	0.00E+00	0.00E+00	7.98E-06*	1.85E-04	4.80E-04	4.25E-04	4.12E-04	4.02E-04	4.13E-04	3.55E-04	3.37E-04	2.60E-04
Mandible	0.00E+00	4.99E-06†	2.36E-04	4.65E-03	1.25E-02	7.81E-03	5.11E-03	4.59E-03	4.19E-03	3.99E-03	3.83E-03	3.20E-03
Other Tissues	1.38E-02	4.08E-02	7.59E-02	1.23E-01	1.11E-01	8.27E-02	8.39E-02	8.72E-02	8.18E-02	7.58E-02	7.05E-02	5.61E-02
Skin	8.99E-06*	2.58E-04	1.11E-03	2.47E-03	2.66E-03	2.27E-03	2.46E-03	2.71E-03	2.50E-03	2.28E-03	2.09E-03	1.67E-03
Spinal Col.	3.89E-04	3.45E-03	6.19E-03	6.54E-03	3.71E-03	2.42E-03	2.59E-03	2.63E-03	2.48E-03	2.27E-03	2.10E-03	1.63E-03
Spinal Skel.	9.76E-01	9.27E-01	8.50E-01	6.34E-01	2.95E-01	9.78E-02	7.18E-02	7.01E-02	6.32E-02	5.60E-02	5.04E-02	3.44E-02
Thalami	0.00E+00	0.00E+00	1.50E-05	2.99E-04	5.95E-04	5.08E-04	4.87E-04	5.07E-04	4.53E-04	4.13E-04	3.81E-04	3.14E-04
Thyroid	0.00E+00	5.40E-05	2.79E-04	5.85E-04	5.87E-04	4.35E-04	4.12E-04	4.06E-04	3.64E-04	3.47E-04	3.10E-04	2.65E-04
Trunk	1.44E-03	4.88E-03	1.22E-02	3.27E-02	4.78E-02	4.25E-02	4.35E-02	4.79E-02	4.85E-02	4.66E-02	4.48E-02	3.88E-02
White Matter	0.00E+00	1.90E-05	5.36E-04	5.30E-03	1.13E-02	1.05E-02	1.03E-02	1.05E-02	1.01E-02	9.31E-03	8.70E-03	7.36E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-06	1.21E-05	6.66E-05	1.40E-04	2.25E-04	5.80E-04	6.21E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E-07‡	3.14E-07*	1.30E-06*	1.04E-06	1.07E-06	3.47E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.33E-07‡	2.34E-06*	1.44E-05	2.92E-05	4.49E-05	1.87E-04	2.29E-03
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E-07‡	3.60E-06	2.19E-05	5.23E-05	8.42E-05	2.73E-04	3.63E-03
Cranium	5.19E-06*	4.21E-06†	6.67E-06*	1.45E-05	3.79E-05	1.14E-04	3.58E-04	1.43E-03	3.73E-03	6.27E-03	8.27E-03	1.23E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-07‡	2.04E-07‡	5.73E-07†	9.26E-07*	4.81E-07	1.55E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.15E-08‡	9.02E-07*	2.11E-06*	2.52E-06	4.22E-06	9.65E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.74E-07‡	1.93E-06*	4.29E-06	2.01E-05	3.18E-05	4.70E-05	5.48E-05	1.02E-04
Other Tissues	2.26E-05*	4.17E-05	7.09E-05	1.29E-04	3.12E-04	1.17E-03	3.66E-03	1.43E-02	3.64E-02	6.12E-02	8.71E-02	1.81E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.06E-07‡	5.83E-07*	5.09E-06	1.29E-05	2.08E-05	2.69E-05	8.42E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.15E-07‡	2.04E-06†	2.72E-06	9.13E-06	1.78E-05	7.06E-04	3.79E-03	1.94E-02
Spinal Skel.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.73E-01	9.32E-01	8.86E-01	8.39E-01	6.69E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-07†	1.64E-06*	2.17E-06	3.15E-06	4.66E-06	1.00E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.31E-08‡	0.00E+00	5.09E-07‡	7.09E-07*	2.26E-06*	2.42E-06	3.77E-06	3.25E-05
Trunk	2.04E-06†	9.61E-07‡	2.70E-06†	9.10E-06*	3.49E-05	1.13E-04	3.63E-04	1.44E-03	3.70E-03	6.27E-03	9.08E-03	2.00E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-06*	5.57E-06*	2.65E-05	5.14E-05	8.66E-05	1.05E-04	2.53E-04

Table A.39: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Thalami.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.97E-01	9.53E-01	7.04E-01	3.49E-01	2.00E-01	1.95E-01	1.95E-01	1.79E-01	1.62E-01	1.48E-01	1.11E-01
Caud. Nucl.	3.40E-03	1.37E-02	1.81E-02	1.39E-02	5.98E-03	3.30E-03	3.23E-03	3.30E-03	3.05E-03	2.74E-03	2.57E-03	1.92E-03
Cerebellum	0.00E+00	3.15E-04	5.86E-03	1.89E-02	1.55E-02	9.53E-03	8.80E-03	8.40E-03	7.62E-03	7.10E-03	6.75E-03	5.41E-03
Cereb. Cort.	5.20E-05	1.01E-02	5.22E-02	9.94E-02	7.05E-02	4.23E-02	3.95E-02	3.85E-02	3.56E-02	3.30E-02	3.03E-02	2.47E-02
Cranium	2.00E-06‡	2.75E-03	2.90E-02	9.30E-02	7.51E-02	2.80E-02	1.64E-02	1.40E-02	1.29E-02	1.20E-02	1.11E-02	9.16E-03
Eyes	0.00E+00	0.00E+00	4.99E-06†	2.26E-04	5.06E-04	4.61E-04	4.70E-04	4.76E-04	4.40E-04	3.88E-04	3.54E-04	3.25E-04
Lent. Nucl.	3.89E-02	7.93E-02	7.99E-02	4.70E-02	1.83E-02	1.01E-02	1.03E-02	1.06E-02	9.84E-03	8.95E-03	8.21E-03	5.88E-03
Mandible	0.00E+00	8.97E-06*	9.49E-04	1.21E-02	2.12E-02	1.14E-02	7.17E-03	6.04E-03	5.51E-03	5.03E-03	4.74E-03	3.97E-03
Other Tissues	0.00E+00	3.36E-04	8.56E-03	4.78E-02	5.53E-02	4.05E-02	3.79E-02	3.78E-02	3.55E-02	3.27E-02	3.01E-02	2.48E-02
Skin	0.00E+00	1.00E-06‡	1.21E-04	1.71E-03	2.62E-03	2.24E-03	2.27E-03	2.42E-03	2.30E-03	2.07E-03	1.89E-03	1.57E-03
Spinal Col.	0.00E+00	0.00E+00	1.32E-05*	1.26E-04	1.78E-04	1.60E-04	1.34E-04	1.26E-04	1.09E-04	1.02E-04	9.72E-05	7.31E-05
Spinal Skel.	0.00E+00	5.94E-06*	5.74E-04	7.28E-03	1.22E-02	6.36E-03	3.70E-03	2.87E-03	2.52E-03	2.30E-03	2.10E-03	1.65E-03
Thalami	8.59E-01	6.04E-01	3.75E-01	1.51E-01	4.91E-02	2.79E-02	3.05E-02	3.21E-02	2.83E-02	2.40E-02	2.02E-02	1.13E-02
Thyroid	0.00E+00	0.00E+00	1.08E-08‡	1.49E-05	5.61E-05	4.52E-05	4.60E-05	5.00E-05	4.29E-05	3.73E-05	4.07E-05	3.53E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	3.64E-04	2.07E-03	2.96E-03	3.32E-03	4.60E-03	5.54E-03	5.89E-03	6.08E-03	6.09E-03
White Matter	9.28E-02	2.60E-01	3.79E-01	3.41E-01	1.76E-01	9.89E-02	9.51E-02	9.49E-02	8.72E-02	7.96E-02	7.38E-02	5.70E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	8.15E-07‡	0.00E+00	1.77E-06*	1.04E-05	2.40E-04	1.71E-03	4.54E-03	8.17E-03	2.07E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.62E-07‡	2.69E-06*	8.25E-06	1.93E-05	4.23E-05	6.35E-05	8.38E-05	1.49E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.76E-06	1.03E-05	3.34E-05	1.04E-04	2.10E-04	2.98E-04	3.83E-04	4.81E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E-06‡	1.17E-05	2.79E-05	7.58E-05	1.28E-04	1.67E-04	1.97E-04	3.43E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.29E-07‡	1.20E-06*	1.88E-06*	2.84E-06	4.18E-06	5.77E-06
Lent. Nucl.	1.74E-05*	3.62E-05	5.96E-05	1.46E-04	3.37E-04	1.08E-03	3.55E-03	1.35E-02	3.36E-02	5.30E-02	7.06E-02	1.06E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.98E-06*	7.62E-06	2.33E-05	3.95E-05	5.48E-05	6.78E-05	1.15E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.86E-07†	7.24E-06	2.63E-05	7.63E-05	1.70E-04	2.65E-04	3.35E-04	6.33E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.60E-07‡	1.38E-06*	3.95E-06	7.95E-06	1.43E-05	2.05E-05	3.93E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.01E-09‡	4.38E-08†	4.01E-07	1.45E-06*	8.97E-07	2.36E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.38E-06*	2.12E-06*	1.15E-05	2.16E-05	2.74E-05	3.90E-05	5.77E-05
Thalami	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.96E-01	9.89E-01	9.55E-01	8.82E-01	8.03E-01	7.25E-01	4.70E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-07*	5.74E-08‡	7.52E-07†	7.31E-07*	6.36E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.18E-07‡	4.86E-06	1.57E-05	2.21E-05	3.42E-05	8.15E-05
White Matter	4.04E-05	7.87E-05	1.17E-04	2.77E-04	7.33E-04	2.34E-03	7.42E-03	3.00E-02	7.74E-02	1.26E-01	1.72E-01	3.41E-01

Table A.40: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Third Ventricle.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.98E-01	9.66E-01	7.28E-01	3.63E-01	2.08E-01	2.02E-01	2.02E-01	1.85E-01	1.67E-01	1.52E-01	1.15E-01
Caud. Nucl.	1.10E-05	3.20E-03	1.03E-02	1.09E-02	5.34E-03	2.90E-03	2.80E-03	2.83E-03	2.62E-03	2.28E-03	2.15E-03	1.75E-03
Cerebellum	0.00E+00	3.81E-04	6.12E-03	2.02E-02	1.63E-02	9.90E-03	9.06E-03	8.67E-03	7.96E-03	7.40E-03	6.90E-03	5.71E-03
Cereb. Cort.	5.00E-06*	6.17E-03	4.46E-02	9.83E-02	7.13E-02	4.28E-02	3.97E-02	3.91E-02	3.59E-02	3.28E-02	3.04E-02	2.49E-02
Cranium	0.00E+00	1.25E-03	2.03E-02	8.32E-02	7.22E-02	2.74E-02	1.60E-02	1.36E-02	1.24E-02	1.15E-02	1.08E-02	8.91E-03
Eyes	0.00E+00	0.00E+00	1.59E-05*	2.65E-04	5.61E-04	4.73E-04	4.65E-04	4.62E-04	4.55E-04	4.28E-04	3.63E-04	3.21E-04
Lent. Nucl.	3.26E-04	1.48E-02	3.39E-02	2.99E-02	1.33E-02	7.28E-03	7.13E-03	7.17E-03	6.57E-03	6.02E-03	5.51E-03	4.39E-03
Mandible	0.00E+00	2.00E-06‡	5.47E-04	9.69E-03	1.84E-02	1.03E-02	6.48E-03	5.40E-03	4.97E-03	4.55E-03	4.31E-03	3.65E-03
Other Tissues	0.00E+00	1.44E-04	5.91E-03	3.95E-02	4.99E-02	3.65E-02	3.45E-02	3.43E-02	3.21E-02	2.97E-02	2.74E-02	2.27E-02
Skin	0.00E+00	1.00E-06‡	9.58E-05	1.70E-03	2.62E-03	2.20E-03	2.30E-03	2.44E-03	2.27E-03	2.04E-03	1.90E-03	1.59E-03
Spinal Col.	0.00E+00	0.00E+00	1.41E-05*	1.22E-04	1.90E-04	1.43E-04	1.39E-04	1.32E-04	1.18E-04	9.09E-05	1.09E-04	8.58E-05
Spinal Skel.	0.00E+00	3.00E-06†	4.95E-04	6.46E-03	1.16E-02	5.92E-03	3.47E-03	2.69E-03	2.42E-03	2.20E-03	2.09E-03	1.55E-03
Thalami	4.41E-02	1.67E-01	1.69E-01	8.90E-02	3.20E-02	1.75E-02	1.83E-02	1.91E-02	1.75E-02	1.63E-02	1.49E-02	1.03E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.82E-05	4.54E-05	4.36E-05	4.06E-05	4.78E-05	5.07E-05	4.34E-05	3.47E-05	2.89E-05
Trunk	0.00E+00	0.00E+00	1.00E-06‡	3.20E-04	1.84E-03	2.59E-03	3.15E-03	4.38E-03	5.32E-03	5.76E-03	5.88E-03	5.97E-03
White Matter	3.47E-01	4.78E-01	5.02E-01	3.92E-01	1.94E-01	1.10E-01	1.06E-01	1.06E-01	9.81E-02	8.88E-02	8.08E-02	6.08E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	6.56E-07‡	0.00E+00	1.80E-06*	3.24E-06	1.07E-05	1.59E-05	2.63E-05	2.92E-05	4.59E-04
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.15E-08‡	1.69E-06*	7.42E-06	2.51E-05	4.32E-05	7.19E-05	8.50E-05	1.62E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.29E-07‡	4.28E-06*	1.07E-05	3.19E-05	1.06E-04	2.04E-04	2.96E-04	3.81E-04	1.01E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-06†	1.03E-05	2.70E-05	6.81E-05	1.17E-04	1.54E-04	1.92E-04	3.08E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-07‡	1.02E-06*	1.04E-06	2.64E-06	3.79E-06	7.69E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E-06†	4.93E-06	9.59E-06	2.39E-05	4.31E-05	6.13E-05	1.56E-04	1.56E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-06†	6.21E-06	1.81E-05	3.43E-05	5.07E-05	6.28E-05	1.10E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-06‡	5.88E-06	1.66E-05	7.07E-05	1.50E-04	2.31E-04	3.05E-04	5.67E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.71E-07‡	7.94E-07*	3.63E-06	9.30E-06	1.56E-05	2.03E-05	4.08E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E-09‡	1.25E-07†	5.62E-07†	6.48E-07*	2.13E-06*	2.29E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.79E-06*	4.81E-06*	1.14E-05	1.92E-05	2.65E-05	3.53E-05	5.40E-05
Thalami	0.00E+00	0.00E+00	2.90E-06†	2.18E-06†	6.31E-06*	1.73E-05	3.54E-05	8.62E-05	1.03E-02	6.14E-02	1.33E-01	2.68E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.82E-09‡	1.07E-07‡	3.74E-07*	1.28E-07*	8.52E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.81E-07‡	1.16E-06†	4.89E-06	1.21E-05	2.21E-05	3.29E-05	7.74E-05
White Matter	2.00E-04	4.23E-04	7.86E-04	1.49E-03	3.79E-03	1.23E-02	3.91E-02	1.54E-01	3.68E-01	4.90E-01	5.18E-01	4.93E-01

Table A.41: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the Thyroid.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	7.63E-05	3.30E-03	9.50E-03	9.56E-03	1.00E-02	1.12E-02	1.12E-02	1.08E-02	1.02E-02	8.97E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	3.33E-05	8.90E-05	7.45E-05	8.23E-05	9.20E-05	9.08E-05	8.14E-05	9.17E-05	6.63E-05
Cerebellum	0.00E+00	0.00E+00	9.29E-07‡	1.46E-04	8.47E-04	1.01E-03	1.08E-03	1.27E-03	1.25E-03	1.21E-03	1.16E-03	1.02E-03
Cereb. Cort.	0.00E+00	0.00E+00	4.65E-05	1.34E-03	3.46E-03	3.49E-03	3.73E-03	4.27E-03	4.28E-03	4.11E-03	3.89E-03	3.38E-03
Cranium	0.00E+00	0.00E+00	1.98E-04	3.20E-03	6.27E-03	3.83E-03	2.52E-03	2.28E-03	2.26E-03	2.21E-03	2.15E-03	1.84E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	1.31E-06‡	2.85E-05	5.85E-05	7.69E-05	9.38E-05	1.06E-04	8.51E-05	9.85E-05	8.01E-05
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	8.14E-05	2.40E-04	2.19E-04	2.14E-04	2.46E-04	2.16E-04	2.04E-04	2.08E-04	1.68E-04
Mandible	0.00E+00	4.48E-05	1.48E-03	1.24E-02	1.68E-02	7.99E-03	4.97E-03	4.25E-03	3.86E-03	3.52E-03	3.37E-03	2.72E-03
Other Tissues	2.41E-01	4.80E-01	5.16E-01	3.55E-01	1.66E-01	9.96E-02	1.01E-01	1.06E-01	9.88E-02	9.13E-02	8.37E-02	6.40E-02
Skin	0.00E+00	1.10E-03	3.49E-03	4.25E-03	2.60E-03	1.78E-03	1.93E-03	2.04E-03	1.94E-03	1.76E-03	1.58E-03	1.32E-03
Spinal Col.	0.00E+00	2.00E-06‡	1.09E-04	8.49E-04	8.36E-04	6.42E-04	6.32E-04	6.28E-04	6.03E-04	5.32E-04	4.97E-04	4.49E-04
Spinal Skel.	2.00E-05	7.31E-03	3.67E-02	8.12E-02	6.40E-02	2.44E-02	1.57E-02	1.42E-02	1.33E-02	1.21E-02	1.14E-02	9.24E-03
Thalami	0.00E+00	0.00E+00	2.03E-06‡	9.76E-05	2.45E-04	2.04E-04	2.08E-04	2.19E-04	1.93E-04	1.95E-04	1.91E-04	1.54E-04
Thyroid	7.47E-01	4.40E-01	2.43E-01	8.76E-02	2.67E-02	1.56E-02	1.74E-02	1.82E-02	1.55E-02	1.25E-02	1.01E-02	4.80E-03
Trunk	1.12E-02	6.00E-02	1.32E-01	2.04E-01	1.65E-01	1.11E-01	1.07E-01	1.12E-01	1.08E-01	1.01E-01	9.54E-02	7.95E-02
White Matter	0.00E+00	0.00E+00	2.68E-05	1.54E-03	4.47E-03	4.40E-03	4.54E-03	4.97E-03	4.97E-03	4.85E-03	4.52E-03	4.03E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.88E-08‡	3.08E-06	1.78E-05	4.64E-05	6.51E-05	8.49E-05	1.74E-04
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-07‡	7.86E-07†	2.44E-07	4.94E-07	1.64E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.53E-08‡	1.56E-06*	3.88E-06	7.52E-06	9.95E-06	2.22E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.88E-08‡	6.35E-07*	7.36E-06	1.62E-05	2.37E-05	3.14E-05	6.50E-05
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.17E-08‡	3.06E-06	5.91E-06	1.49E-05	1.98E-05	2.21E-05	4.67E-05
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.14E-08‡	0.00E+00	4.25E-07‡	5.04E-07*	8.72E-07	2.22E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-07‡	5.71E-07*	1.09E-06	1.39E-06*	1.67E-06	3.43E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.85E-07†	5.33E-06*	1.73E-05	2.77E-05	4.18E-05	5.06E-05	8.42E-05
Other Tissues	1.29E-04	2.68E-04	4.30E-04	9.28E-04	2.12E-03	7.29E-03	2.27E-02	8.74E-02	2.14E-01	3.35E-01	4.36E-01	6.13E-01
Skin	0.00E+00	0.00E+00	0.00E+00	4.55E-08‡	0.00E+00	2.79E-07‡	1.45E-06†	4.33E-06	1.06E-05	1.53E-05	1.72E-05	1.29E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.91E-09‡	4.72E-07‡	8.52E-07†	3.15E-06	4.00E-06	5.65E-06	1.21E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.52E-07‡	6.49E-06*	2.27E-05	6.09E-05	1.15E-04	1.55E-04	1.91E-04	1.91E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.83E-08‡	3.88E-07*	8.66E-07	1.15E-06	1.90E-06	4.66E-06
Thyroid	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.77E-01	9.09E-01	7.75E-01	6.43E-01	5.29E-01	2.87E-01
Trunk	0.00E+00	0.00E+00	7.96E-07‡	3.44E-06†	1.59E-05	6.55E-05	2.95E-04	1.88E-03	7.35E-03	1.57E-02	2.62E-02	7.80E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.92E-06*	7.64E-06	2.29E-05	2.86E-05	3.69E-05	7.44E-05

Table A.42: Absorbed Fractions for the 5-year-old Phantom for Sources Located in the White Matter.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.78E-01	8.89E-01	6.12E-01	2.92E-01	1.69E-01	1.68E-01	1.71E-01	1.57E-01	1.42E-01	1.29E-01	9.63E-02
Caud. Nucl.	2.48E-03	6.07E-03	8.03E-03	6.61E-03	3.23E-03	1.81E-03	1.73E-03	1.80E-03	1.62E-03	1.51E-03	1.33E-03	1.07E-03
Cerebellum	1.90E-05*	2.45E-03	9.97E-03	1.77E-02	1.25E-02	7.51E-03	7.18E-03	7.25E-03	6.63E-03	6.21E-03	5.64E-03	4.73E-03
Cereb. Cort.	4.76E-02	1.25E-01	1.71E-01	1.55E-01	8.33E-02	4.91E-02	4.81E-02	4.92E-02	4.57E-02	4.19E-02	3.86E-02	3.04E-02
Cranium	2.20E-04	1.80E-02	7.14E-02	1.25E-01	7.93E-02	2.77E-02	1.73E-02	1.57E-02	1.46E-02	1.36E-02	1.27E-02	1.02E-02
Eyes	0.00E+00	1.30E-05	1.53E-04	6.71E-04	6.94E-04	5.81E-04	5.53E-04	5.81E-04	5.57E-04	4.83E-04	4.65E-04	3.82E-04
Lent. Nucl.	3.16E-03	8.39E-03	1.15E-02	1.02E-02	5.09E-03	2.96E-03	2.80E-03	2.80E-03	2.56E-03	2.38E-03	2.19E-03	1.67E-03
Mandible	0.00E+00	4.58E-05	7.76E-04	6.40E-03	1.14E-02	6.76E-03	4.43E-03	3.92E-03	3.60E-03	3.46E-03	3.28E-03	2.77E-03
Other Tissues	0.00E+00	4.05E-04	5.51E-03	2.43E-02	2.97E-02	2.32E-02	2.27E-02	2.34E-02	2.22E-02	2.08E-02	1.91E-02	1.57E-02
Skin	0.00E+00	1.16E-04	1.24E-03	3.71E-03	3.43E-03	2.58E-03	2.72E-03	3.03E-03	2.66E-03	2.49E-03	2.28E-03	1.83E-03
Spinal Col.	0.00E+00	2.00E-06‡	1.21E-05*	6.16E-05	9.05E-05	7.93E-05	8.94E-05	8.38E-05	7.71E-05	6.66E-05	6.95E-05	5.85E-05
Spinal Skel.	0.00E+00	1.79E-05	3.98E-04	3.48E-03	6.38E-03	3.46E-03	2.09E-03	1.79E-03	1.62E-03	1.51E-03	1.39E-03	1.16E-03
Thalami	2.38E-03	6.51E-03	9.47E-03	8.72E-03	4.48E-03	2.52E-03	2.43E-03	2.46E-03	2.22E-03	2.00E-03	1.84E-03	1.46E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	7.73E-06*	2.25E-05	2.86E-05	2.60E-05	3.16E-05	2.95E-05	2.57E-05	2.92E-05	2.51E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.31E-04	1.00E-03	1.50E-03	1.89E-03	2.65E-03	3.38E-03	3.57E-03	3.65E-03	3.76E-03
White Matter	9.39E-01	8.18E-01	6.64E-01	4.00E-01	1.77E-01	1.01E-01	1.02E-01	1.04E-01	9.45E-02	8.48E-02	7.64E-02	5.48E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.69E-01
Caud. Nucl.	0.00E+00	1.90E-06‡	1.85E-06†	6.32E-06	1.71E-05	8.05E-05	2.06E-04	8.86E-04	2.09E-03	3.34E-03	4.51E-03	7.93E-03
Cerebellum	0.00E+00	0.00E+00	6.18E-07‡	1.16E-06‡	1.07E-06‡	2.21E-06*	3.55E-06	1.72E-05	3.48E-05	5.57E-05	7.26E-05	2.11E-03
Cereb. Cort.	1.58E-05	4.72E-05	6.17E-05	1.44E-04	3.37E-04	1.20E-03	3.75E-03	1.50E-02	3.89E-02	6.46E-02	9.00E-02	1.66E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	1.37E-06‡	4.63E-06*	1.51E-05	3.47E-05	8.60E-05	1.45E-04	1.95E-04	2.81E-04	1.17E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.41E-07‡	2.33E-07‡	8.37E-07*	3.42E-06	3.22E-06	4.26E-06	4.78E-05
Lent. Nucl.	2.01E-06†	1.69E-06†	5.24E-06†	1.21E-05*	2.21E-05	8.37E-05	2.86E-04	1.13E-03	2.65E-03	4.30E-03	5.89E-03	1.06E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.46E-06†	3.44E-06	1.23E-05	2.21E-05	3.49E-05	4.14E-05	1.28E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E-06*	1.17E-05	4.41E-05	1.04E-04	1.55E-04	2.02E-04	9.32E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-07†	1.82E-06*	4.13E-06	1.07E-05	1.77E-05	2.65E-05	3.32E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.79E-08‡	2.76E-07*	8.28E-07‡	4.16E-07	1.88E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	6.88E-07‡	0.00E+00	7.27E-07‡	2.16E-06*	7.16E-06	1.20E-05	1.87E-05	2.07E-05	4.42E-05
Thalami	0.00E+00	1.78E-06‡	3.05E-06†	5.60E-06†	1.86E-05	5.75E-05	1.86E-04	8.04E-04	2.02E-03	3.27E-03	4.48E-03	8.70E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-08‡	2.28E-08†	2.43E-07*	1.05E-07†	7.74E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.52E-07‡	5.52E-07†	2.90E-06*	1.08E-05	1.18E-05	1.51E-05	5.26E-05
White Matter	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.79E-01	9.46E-01	9.12E-01	8.78E-01	7.58E-01

Absorbed Fractions of Energy in a Mathematical Model of the Head and Brain of a Ten-Year-Old

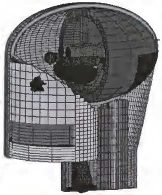


Table A.43: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Brain (Total).

Photon Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.75E-01	9.14E-01	8.09E-01	5.51E-01	2.67E-01	1.56E-01	1.55E-01	1.58E-01	1.45E-01	1.31E-01	1.19E-01	8.92E-02
Caud. Nucl.	7.53E-03	7.51E-03	7.18E-03	5.30E-03	2.61E-03	1.53E-03	1.46E-03	1.49E-03	1.34E-03	1.26E-03	1.12E-03	8.13E-04
Cerebellum	9.64E-02	8.86E-02	7.61E-02	5.00E-02	2.40E-02	1.41E-02	1.42E-02	1.45E-02	1.30E-02	1.20E-02	1.08E-02	8.12E-03
Cereb. Cort.	4.19E-01	3.73E-01	3.16E-01	2.09E-01	1.02E-01	6.01E-02	6.00E-02	6.18E-02	5.70E-02	5.13E-02	4.67E-02	3.48E-02
Cranium	1.49E-02	7.09E-02	1.43E-01	1.86E-01	1.08E-01	3.73E-02	2.43E-02	2.25E-02	2.08E-02	1.95E-02	1.80E-02	1.43E-02
Eyes	0.00E+00	1.54E-06‡	5.51E-05	3.74E-04	4.73E-04	4.24E-04	4.47E-04	4.66E-04	4.38E-04	3.90E-04	3.68E-04	3.30E-04
Lent. Nucl.	1.39E-02	1.38E-02	1.30E-02	9.44E-03	4.63E-03	2.64E-03	2.67E-03	2.64E-03	2.37E-03	2.16E-03	1.92E-03	1.47E-03
Mandible	0.00E+00	4.49E-05	6.80E-04	5.31E-03	9.91E-03	5.93E-03	3.99E-03	3.64E-03	3.42E-03	3.23E-03	3.05E-03	2.51E-03
Other Tissues	0.00E+00	6.00E-04	6.09E-03	2.53E-02	3.10E-02	2.47E-02	2.45E-02	2.52E-02	2.43E-02	2.25E-02	2.11E-02	1.75E-02
Skin	0.00E+00	2.35E-04	1.62E-03	4.33E-03	3.98E-03	2.97E-03	3.16E-03	3.46E-03	3.22E-03	2.91E-03	2.70E-03	2.15E-03
Spinal Col.	0.00E+00	2.00E-06‡	1.91E-05	8.97E-05	9.62E-05	9.56E-05	8.41E-05	9.79E-05	8.81E-05	9.64E-05	9.26E-05	7.41E-05
Spinal Skel.	0.00E+00	3.49E-05	6.15E-04	4.21E-03	7.24E-03	4.01E-03	2.49E-03	2.12E-03	1.96E-03	1.79E-03	1.67E-03	1.39E-03
Thalami	1.14E-02	1.14E-02	1.09E-02	8.22E-03	4.13E-03	2.35E-03	2.29E-03	2.26E-03	2.08E-03	1.93E-03	1.77E-03	1.29E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	4.96E-06*	3.87E-05	4.37E-05	4.86E-05	5.68E-05	4.72E-05	5.50E-05	4.55E-05	4.86E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	7.15E-05	8.13E-04	1.48E-03	1.88E-03	2.85E-03	3.59E-03	3.98E-03	4.18E-03	4.41E-03
White Matter	4.12E-01	4.04E-01	3.70E-01	2.58E-01	1.24E-01	7.24E-02	7.12E-02	7.22E-02	6.64E-02	5.97E-02	5.44E-02	4.08E-02

Electron Absorbed Fraction of Energy: ϕ

	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.91E-01	9.77E-01	9.61E-01	9.46E-01	8.84E-01
Caud. Nucl.	7.40E-03	7.51E-03	7.45E-03	7.51E-03	7.47E-03	7.50E-03	7.42E-03	7.56E-03	7.60E-03	7.44E-03	7.60E-03	7.28E-03
Cerebellum	9.99E-02	9.96E-02	9.94E-02	9.93E-02	1.00E-01	9.98E-02	9.98E-02	9.86E-02	9.65E-02	9.48E-02	9.24E-02	8.51E-02
Cereb. Cort.	4.41E-01	4.40E-01	4.41E-01	4.41E-01	4.41E-01	4.39E-01	4.38E-01	4.33E-01	4.22E-01	4.10E-01	3.97E-01	3.51E-01
Cranium	0.00E+00	6.56E-07‡	7.01E-07‡	1.73E-06†	7.43E-06	2.38E-05	5.37E-05	6.79E-04	9.20E-03	2.17E-02	3.40E-02	6.29E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-08‡	8.89E-07*	2.29E-06*	3.06E-06	4.29E-06	3.88E-05
Lent. Nucl.	1.40E-02	1.37E-02	1.39E-02	1.38E-02	1.39E-02	1.38E-02	1.40E-02	1.39E-02	1.39E-02	1.37E-02	1.37E-02	1.36E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-06*	3.72E-06*	1.01E-05	2.08E-05	3.07E-05	4.97E-05	3.52E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.88E-07†	3.71E-06	1.28E-05	5.05E-05	1.11E-04	1.66E-04	3.77E-04	6.78E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.30E-07†	1.64E-06*	5.65E-06	1.50E-05	2.23E-05	1.55E-04	3.43E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.18E-08‡	1.81E-07‡	8.82E-08‡	3.91E-07*	5.44E-07*	1.09E-06*	1.88E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-06†	1.99E-06†	6.42E-06	1.28E-05	2.05E-05	3.35E-05	3.81E-04
Thalami	1.14E-02	1.15E-02	1.14E-02	1.16E-02	1.14E-02	1.16E-02	1.13E-02	1.15E-02	1.15E-02	1.14E-02	1.13E-02	1.12E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-08‡	9.93E-08†	4.33E-07†	4.49E-07*	1.29E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.18E-07†	2.39E-06*	7.23E-06	1.01E-05	1.94E-05	5.95E-05
White Matter	4.11E-01	4.12E-01	4.11E-01	4.11E-01	4.11E-01	4.12E-01	4.11E-01	4.11E-01	4.10E-01	4.09E-01	4.08E-01	4.01E-01

Table A.44: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Caudate Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.98E-01	9.58E-01	7.06E-01	3.49E-01	2.00E-01	1.95E-01	1.97E-01	1.80E-01	1.62E-01	1.48E-01	1.13E-01
Caud. Nucl.	8.03E-01	4.98E-01	2.79E-01	1.03E-01	3.25E-02	1.89E-02	2.08E-02	2.20E-02	1.90E-02	1.55E-02	1.25E-02	6.14E-03
Cerebellum	0.00E+00	3.79E-05	1.47E-03	7.97E-03	8.29E-03	5.46E-03	5.02E-03	4.89E-03	4.54E-03	4.07E-03	3.84E-03	3.22E-03
Cereb. Cort.	2.20E-05	7.79E-03	5.16E-02	1.08E-01	7.73E-02	4.66E-02	4.34E-02	4.28E-02	3.94E-02	3.59E-02	3.36E-02	2.75E-02
Cranium	0.00E+00	1.81E-03	2.83E-02	1.05E-01	8.89E-02	3.40E-02	2.02E-02	1.73E-02	1.59E-02	1.48E-02	1.38E-02	1.13E-02
Eyes	0.00E+00	0.00E+00	4.50E-05	5.72E-04	8.16E-04	7.17E-04	7.22E-04	7.21E-04	6.55E-04	6.36E-04	5.61E-04	4.82E-04
Lent. Nucl.	3.92E-02	7.68E-02	7.54E-02	4.28E-02	1.69E-02	9.32E-03	9.55E-03	9.92E-03	9.18E-03	8.30E-03	7.58E-03	5.35E-03
Mandible	0.00E+00	3.96E-06†	4.88E-04	6.88E-03	1.38E-02	8.32E-03	5.41E-03	4.57E-03	4.35E-03	3.97E-03	3.79E-03	3.15E-03
Other Tissues	0.00E+00	4.24E-05	2.13E-03	2.07E-02	3.22E-02	2.66E-02	2.55E-02	2.58E-02	2.45E-02	2.27E-02	2.11E-02	1.75E-02
Skin	0.00E+00	2.97E-06†	2.71E-04	2.31E-03	3.04E-03	2.58E-03	2.67E-03	2.88E-03	2.73E-03	2.41E-03	2.24E-03	1.85E-03
Spinal Col.	0.00E+00	0.00E+00	4.11E-06*	3.45E-05	7.88E-05	6.53E-05	7.56E-05	5.68E-05	4.88E-05	4.79E-05	4.16E-05	2.96E-05
Spinal Skel.	0.00E+00	0.00E+00	3.65E-05	1.72E-03	4.93E-03	3.18E-03	1.92E-03	1.39E-03	1.30E-03	1.15E-03	1.00E-03	8.51E-04
Thalami	4.13E-03	1.92E-02	2.64E-02	2.02E-02	9.18E-03	5.08E-03	4.95E-03	5.01E-03	4.46E-03	4.21E-03	3.84E-03	3.00E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.01E-05	4.74E-05	4.48E-05	5.22E-05	6.58E-05	6.42E-05	4.72E-05	5.90E-05	5.05E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	8.69E-05	9.63E-04	1.64E-03	2.02E-03	2.97E-03	3.79E-03	4.24E-03	4.34E-03	4.62E-03
White Matter	1.50E-01	3.69E-01	4.84E-01	3.94E-01	1.92E-01	1.08E-01	1.05E-01	1.05E-01	9.67E-02	8.81E-02	8.10E-02	6.31E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.84E-01	9.35E-01	8.34E-01	7.26E-01	6.20E-01	3.30E-01
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-06*	2.53E-06	8.84E-06	2.22E-05	3.60E-05	4.60E-05	8.16E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	4.55E-08‡	2.86E-06†	1.10E-05	3.28E-05	1.09E-04	2.18E-04	3.41E-04	4.28E-04	2.13E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	1.32E-08‡	2.87E-06‡	1.33E-05	3.15E-05	8.18E-05	1.49E-04	2.04E-04	2.43E-04	3.84E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-08‡	5.39E-07†	1.11E-06	2.47E-06	4.90E-06	5.50E-06	1.07E-05
Lent. Nucl.	1.10E-05*	3.16E-05	6.71E-05	1.23E-04	3.02E-04	1.08E-03	3.43E-03	1.36E-02	3.39E-02	5.40E-02	7.13E-02	1.02E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-06*	3.56E-06	1.41E-05	2.66E-05	4.28E-05	5.29E-05	8.80E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.74E-07‡	2.83E-06†	1.15E-05	4.78E-05	1.06E-04	1.63E-04	2.25E-04	4.16E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.93E-08†	9.25E-07*	5.44E-06	1.40E-05	1.72E-05	2.56E-05	4.35E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.83E-08‡	0.00E+00	1.43E-07‡	6.11E-07‡	3.85E-07*	2.74E-07	6.43E-07
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.92E-07‡	0.00E+00	1.63E-06*	4.49E-06	9.57E-06	1.65E-05	1.46E-05	2.75E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-06†	2.60E-06*	5.99E-06	1.47E-04	1.89E-03	5.65E-03	1.06E-02	2.92E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.03E-09‡	3.73E-07†	3.85E-07*	3.16E-07*	7.05E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-06†	2.15E-06	8.41E-06	1.65E-05	2.32E-05	5.83E-05
White Matter	6.83E-05	1.44E-04	2.39E-04	4.80E-04	1.21E-03	4.01E-03	1.24E-02	4.95E-02	1.27E-01	2.06E-01	2.80E-01	4.79E-01

Table A.45: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Cerebellum.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.67E-01	8.91E-01	7.69E-01	5.05E-01	2.41E-01	1.42E-01	1.42E-01	1.45E-01	1.33E-01	1.20E-01	1.09E-01	8.12E-02
Caud. Nucl.	0.00E+00	5.00E-06†	1.25E-04	5.66E-04	6.39E-04	4.08E-04	3.72E-04	3.82E-04	3.44E-04	2.95E-04	2.98E-04	2.51E-04
Cerebellum	9.32E-01	7.86E-01	5.92E-01	2.99E-01	1.12E-01	6.38E-02	6.67E-02	6.95E-02	6.32E-02	5.60E-02	4.94E-02	3.30E-02
Cereb. Cort.	3.53E-02	9.63E-02	1.39E-01	1.30E-01	7.27E-02	4.34E-02	4.26E-02	4.36E-02	4.05E-02	3.70E-02	3.44E-02	2.74E-02
Cranium	1.95E-02	9.03E-02	1.75E-01	2.13E-01	1.16E-01	3.92E-02	2.59E-02	2.40E-02	2.23E-02	2.06E-02	1.92E-02	1.50E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	1.09E-05†	6.44E-05	9.50E-05	1.07E-04	1.14E-04	1.24E-04	1.28E-04	1.05E-04	1.06E-04
Lent. Nucl.	0.00E+00	6.97E-06†	2.15E-04	1.23E-03	1.20E-03	8.47E-04	7.61E-04	7.26E-04	7.11E-04	6.51E-04	6.16E-04	4.77E-04
Mandible	0.00E+00	0.00E+00	2.08E-05	1.32E-03	4.95E-03	3.70E-03	2.48E-03	2.24E-03	2.17E-03	2.07E-03	1.90E-03	1.67E-03
Other Tissues	0.00E+00	1.01E-03	1.06E-02	3.73E-02	3.99E-02	3.03E-02	3.07E-02	3.22E-02	3.05E-02	2.85E-02	2.67E-02	2.17E-02
Skin	1.00E-06‡	1.86E-04	1.67E-03	4.58E-03	4.01E-03	2.96E-03	3.11E-03	3.39E-03	3.16E-03	2.85E-03	2.63E-03	2.12E-03
Spinal Col.	0.00E+00	3.00E-06†	3.70E-05	1.81E-04	2.35E-04	2.01E-04	1.92E-04	2.01E-04	1.94E-04	1.70E-04	1.66E-04	1.44E-04
Spinal Skel.	0.00E+00	1.11E-04	1.56E-03	1.01E-02	1.52E-02	7.45E-03	4.86E-03	4.35E-03	4.08E-03	3.82E-03	3.54E-03	2.96E-03
Thalami	0.00E+00	1.50E-05	6.08E-04	1.96E-03	1.76E-03	1.06E-03	9.71E-04	8.84E-04	8.93E-04	8.06E-04	7.20E-04	6.00E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	7.89E-06*	4.04E-05	4.27E-05	5.14E-05	5.54E-05	6.16E-05	6.07E-05	5.59E-05	5.14E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	5.62E-05	7.96E-04	1.78E-03	2.31E-03	3.50E-03	4.55E-03	4.96E-03	5.33E-03	5.47E-03
White Matter	5.99E-05	8.07E-03	3.59E-02	6.85E-02	5.03E-02	3.07E-02	2.90E-02	2.89E-02	2.66E-02	2.46E-02	2.29E-02	1.87E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.88E-01	9.70E-01	9.51E-01	9.31E-01	8.55E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.43E-07‡	3.92E-07†	7.42E-07*	2.67E-06	1.92E-06	3.70E-06	6.57E-06
Cerebellum	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.77E-01	9.40E-01	9.01E-01	8.63E-01	7.22E-01
Cereb. Cort.	1.87E-05	2.57E-05	4.94E-05	1.16E-04	3.14E-04	9.59E-04	2.87E-03	1.13E-02	2.92E-02	4.88E-02	6.69E-02	1.28E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	4.30E-06†	8.58E-06*	2.56E-05	5.57E-05	6.89E-04	1.18E-02	2.77E-02	4.46E-02	8.18E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.69E-08†	5.14E-07*	4.35E-07*	5.90E-07*	2.06E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.79E-07‡	4.80E-07‡	1.29E-06*	3.51E-06	5.29E-06	7.59E-06	1.23E-05
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-06*	5.79E-06	1.15E-05	1.62E-05	2.52E-05	4.29E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.35E-06‡	5.55E-06	1.50E-05	6.10E-05	1.35E-04	2.11E-04	5.07E-04	1.46E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.19E-08‡	3.57E-07‡	2.17E-06	6.03E-06	1.53E-05	2.28E-05	1.11E-04	2.70E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.27E-08‡	4.71E-07*	7.95E-07*	1.37E-06*	1.89E-06	3.08E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-08‡	4.17E-06*	3.91E-06*	1.47E-05	2.79E-05	3.65E-05	6.69E-05	1.16E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.33E-07‡	1.12E-06‡	1.91E-06	5.41E-06	7.38E-06	1.05E-05	1.48E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.60E-08‡	2.19E-07*	2.54E-07†	3.33E-07*	8.54E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-07‡	1.14E-06†	3.53E-06	7.72E-06	1.81E-05	3.29E-05	6.10E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-06†	1.21E-05	2.37E-05	7.26E-05	1.51E-04	2.20E-04	2.78E-04	5.17E-03

Table A.46: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Cerebral Cortex.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.50E-01	8.48E-01	7.18E-01	4.75E-01	2.31E-01	1.36E-01	1.37E-01	1.40E-01	1.29E-01	1.16E-01	1.05E-01	7.87E-02
Caud. Nucl.	1.00E-06‡	1.35E-04	8.43E-04	1.88E-03	1.35E-03	8.21E-04	7.32E-04	7.42E-04	6.41E-04	6.15E-04	5.58E-04	4.78E-04
Cerebellum	8.06E-03	2.18E-02	3.12E-02	2.96E-02	1.66E-02	9.84E-03	9.68E-03	9.82E-03	9.09E-03	8.46E-03	7.78E-03	6.17E-03
Cereb. Cort.	8.98E-01	7.02E-01	5.08E-01	2.73E-01	1.17E-01	6.92E-02	7.18E-02	7.45E-02	6.76E-02	6.03E-02	5.39E-02	3.81E-02
Cranium	2.98E-02	1.25E-01	2.12E-01	2.27E-01	1.19E-01	3.95E-02	2.66E-02	2.53E-02	2.38E-02	2.19E-02	2.02E-02	1.58E-02
Eyes	0.00E+00	1.00E-06‡	6.35E-05	3.98E-04	4.73E-04	4.37E-04	4.63E-04	4.82E-04	4.51E-04	4.18E-04	3.91E-04	3.11E-04
Lent. Nucl.	3.80E-05	7.46E-04	2.29E-03	3.50E-03	2.47E-03	1.49E-03	1.37E-03	1.35E-03	1.24E-03	1.12E-03	1.02E-03	8.49E-04
Mandible	0.00E+00	1.10E-04	9.53E-04	5.56E-03	9.77E-03	5.71E-03	3.79E-03	3.42E-03	3.24E-03	3.03E-03	2.93E-03	2.50E-03
Other Tissues	0.00E+00	9.13E-04	7.36E-03	2.52E-02	2.89E-02	2.30E-02	2.30E-02	2.41E-02	2.32E-02	2.16E-02	2.02E-02	1.67E-02
Skin	0.00E+00	3.61E-04	2.41E-03	5.34E-03	4.31E-03	3.25E-03	3.49E-03	3.79E-03	3.52E-03	3.21E-03	2.85E-03	2.34E-03
Spinal Col.	0.00E+00	4.97E-06†	2.51E-05	5.24E-05	1.03E-04	9.18E-05	9.06E-05	8.25E-05	8.55E-05	7.48E-05	8.53E-05	6.54E-05
Spinal Skel.	0.00E+00	4.99E-05	7.70E-04	4.13E-03	6.57E-03	3.58E-03	2.28E-03	1.93E-03	1.81E-03	1.65E-03	1.55E-03	1.31E-03
Thalami	2.00E-06‡	3.05E-04	1.42E-03	2.88E-03	2.11E-03	1.28E-03	1.14E-03	1.18E-03	1.06E-03	9.53E-04	8.80E-04	7.19E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.46E-05	3.57E-05	3.90E-05	4.50E-05	5.39E-05	6.81E-05	5.65E-05	4.75E-05	4.54E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	7.71E-05	7.37E-04	1.28E-03	1.74E-03	2.54E-03	3.25E-03	3.63E-03	3.86E-03	4.03E-03
White Matter	4.47E-02	1.21E-01	1.71E-01	1.59E-01	8.76E-02	5.18E-02	5.03E-02	5.11E-02	4.72E-02	4.32E-02	3.97E-02	3.12E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.96E-01	9.83E-01	9.57E-01	9.28E-01	8.99E-01	7.94E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.01E-07‡	7.36E-07†	1.17E-06*	1.91E-06	3.37E-06	6.27E-06	7.23E-06	4.23E-05
Cerebellum	1.23E-06‡	9.31E-06*	1.25E-05	2.39E-05	6.50E-05	2.06E-04	6.73E-04	2.56E-03	6.61E-03	1.09E-02	1.50E-02	2.91E-02
Cereb. Cort.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.92E-01	9.67E-01	9.14E-01	8.57E-01	7.99E-01	6.01E-01
Cranium	0.00E+00	4.78E-07‡	1.16E-06‡	3.01E-06†	6.70E-06*	2.78E-05	6.50E-05	1.23E-03	1.80E-02	4.22E-02	6.75E-02	1.16E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.95E-08‡	9.34E-07	2.36E-06*	2.69E-06	4.74E-06	9.61E-05
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.08E-07‡	2.42E-07‡	1.26E-06*	3.49E-06	7.80E-06	2.93E-05	1.01E-04	9.15E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.61E-07‡	1.80E-06*	2.75E-06*	1.12E-05	2.04E-05	2.90E-05	6.57E-05	6.99E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	7.59E-08‡	8.92E-07‡	2.26E-06*	1.39E-05	4.85E-05	9.93E-05	1.66E-04	5.26E-04	1.14E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E-06‡	1.43E-06†	7.80E-06	1.51E-05	2.68E-05	3.11E-04	7.08E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.17E-07‡	2.76E-07†	3.00E-07	1.47E-06*	3.89E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.13E-07‡	7.32E-07†	1.44E-06*	6.00E-06	1.28E-05	1.81E-05	2.80E-05	5.68E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E-07‡	7.17E-07†	3.79E-06	5.40E-06	8.96E-06	1.15E-05	1.47E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.04E-09‡	2.65E-07†	3.34E-07*	4.09E-07*	1.22E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-06†	3.73E-06*	7.32E-06	1.18E-05	2.13E-05	4.54E-05
White Matter	2.21E-05*	4.31E-05	5.96E-05	1.29E-04	3.42E-04	1.10E-03	3.56E-03	1.41E-02	3.63E-02	6.07E-02	8.45E-02	1.61E-01

Table A.47: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Cranial CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.21E-01	3.90E-01	3.82E-01	2.91E-01	1.56E-01	9.63E-02	9.68E-02	9.98E-02	9.30E-02	8.50E-02	7.81E-02	6.04E-02
Caud. Nucl.	0.00E+00	4.19E-05	4.13E-04	1.15E-03	8.68E-04	5.49E-04	5.48E-04	5.58E-04	4.90E-04	4.75E-04	4.45E-04	3.37E-04
Cerebellum	4.28E-02	5.14E-02	4.82E-02	3.34E-02	1.68E-02	1.02E-02	1.04E-02	1.07E-02	9.98E-03	9.29E-03	8.47E-03	6.45E-03
Cereb. Cort.	2.77E-01	3.14E-01	2.67E-01	1.65E-01	7.74E-02	4.78E-02	4.92E-02	5.16E-02	4.79E-02	4.36E-02	3.97E-02	2.96E-02
Cranium	3.41E-01	4.52E-01	4.67E-01	3.54E-01	1.56E-01	5.03E-02	3.66E-02	3.61E-02	3.34E-02	2.98E-02	2.68E-02	1.87E-02
Eyes	0.00E+00	6.02E-06‡	9.42E-05	4.17E-04	4.72E-04	4.47E-04	4.51E-04	4.98E-04	4.79E-04	4.59E-04	4.26E-04	3.51E-04
Lent. Nucl.	2.00E-06‡	3.12E-04	1.25E-03	2.31E-03	1.76E-03	1.16E-03	1.04E-03	1.05E-03	9.79E-04	9.03E-04	8.21E-04	6.48E-04
Mandible	0.00E+00	1.70E-04	1.34E-03	6.44E-03	9.93E-03	5.89E-03	3.99E-03	3.68E-03	3.49E-03	3.32E-03	3.13E-03	2.61E-03
Other Tissues	5.51E-06†	2.22E-03	1.29E-02	3.22E-02	3.31E-02	2.60E-02	2.66E-02	2.82E-02	2.71E-02	2.52E-02	2.36E-02	1.90E-02
Skin	1.00E-06‡	8.57E-04	3.66E-03	6.63E-03	4.88E-03	3.75E-03	4.14E-03	4.56E-03	4.10E-03	3.78E-03	3.42E-03	2.66E-03
Spinal Col.	0.00E+00	2.97E-06†	3.10E-05	1.04E-04	1.20E-04	1.10E-04	1.08E-04	1.36E-04	1.13E-04	1.05E-04	9.55E-05	7.91E-05
Spinal Skel.	0.00E+00	1.49E-04	1.24E-03	5.71E-03	7.97E-03	4.11E-03	2.71E-03	2.47E-03	2.29E-03	2.09E-03	1.97E-03	1.56E-03
Thalami	1.00E-06‡	1.14E-04	6.94E-04	1.77E-03	1.41E-03	9.22E-04	8.66E-04	8.06E-04	7.59E-04	6.93E-04	6.59E-04	5.49E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.40E-05	4.09E-05	4.61E-05	4.48E-05	5.64E-05	5.37E-05	5.65E-05	5.52E-05	4.95E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.02E-04	7.90E-04	1.42E-03	1.79E-03	2.60E-03	3.17E-03	3.59E-03	3.87E-03	3.96E-03
White Matter	5.71E-04	2.44E-02	6.42E-02	8.59E-02	5.55E-02	3.45E-02	3.37E-02	3.40E-02	3.19E-02	2.92E-02	2.72E-02	2.21E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.04E-04	6.64E-04	1.18E-03	2.31E-03	5.75E-03	1.94E-02	6.06E-02	2.27E-01	3.53E-01	3.94E-01	4.11E-01	4.25E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-08‡	4.57E-07‡	2.84E-07†	8.20E-07*	2.01E-06	4.31E-06	5.52E-06	9.30E-06
Cerebellum	3.84E-05	8.60E-05	1.30E-04	3.17E-04	7.18E-04	2.62E-03	7.96E-03	3.05E-02	4.75E-02	5.30E-02	5.53E-02	5.57E-02
Cereb. Cort.	2.66E-04	5.78E-04	1.05E-03	1.99E-03	5.02E-03	1.68E-02	5.26E-02	1.96E-01	3.06E-01	3.41E-01	3.56E-01	3.36E-01
Cranium	3.15E-04	7.30E-04	1.18E-03	2.33E-03	5.76E-03	1.93E-02	6.05E-02	2.27E-01	3.60E-01	4.05E-01	4.09E-01	2.95E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.41E-08‡	0.00E+00	7.97E-08‡	1.55E-06	2.77E-06	3.49E-06	4.42E-06	3.02E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-07‡	7.32E-07‡	7.61E-07*	2.93E-06	6.13E-06	8.69E-06	9.85E-06	2.07E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.03E-07‡	2.75E-06	8.57E-06	2.19E-05	7.58E-05	3.83E-04	2.04E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	4.89E-08‡	1.07E-06‡	5.56E-06*	1.75E-05	5.61E-05	1.41E-04	4.90E-04	6.69E-03	4.32E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-08‡	8.04E-08‡	2.42E-06	8.52E-06	2.06E-05	7.14E-05	7.24E-03	1.92E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-07†	2.43E-07*	1.30E-06*	1.56E-05	1.56E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.49E-07‡	3.53E-07‡	2.67E-06*	8.62E-06	1.89E-05	2.51E-05	2.90E-04	2.62E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-06*	2.17E-06	5.12E-06	6.31E-06	9.49E-06	1.91E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-07†	3.65E-07‡	3.13E-07*	1.78E-07*	4.61E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.14E-07‡	0.00E+00	3.32E-06	5.91E-06	1.55E-05	2.03E-05	5.42E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	6.55E-08‡	2.84E-06*	1.38E-05	2.85E-05	8.33E-05	1.80E-04	2.76E-04	5.47E-04	3.32E-02

Table A.48: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Cranium.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.69E-02	7.27E-02	1.42E-01	1.86E-01	1.25E-01	8.15E-02	8.23E-02	8.53E-02	8.03E-02	7.43E-02	6.86E-02	5.49E-02
Caud. Nucl.	0.00E+00	9.98E-06*	2.14E-04	8.59E-04	7.52E-04	5.38E-04	5.01E-04	4.93E-04	4.41E-04	4.44E-04	3.77E-04	3.13E-04
Cerebellum	2.15E-03	9.31E-03	1.75E-02	2.12E-02	1.32E-02	8.71E-03	8.71E-03	9.05E-03	8.58E-03	7.85E-03	7.34E-03	5.74E-03
Cereb. Cort.	1.47E-02	5.67E-02	9.29E-02	9.90E-02	6.03E-02	3.89E-02	4.03E-02	4.24E-02	3.98E-02	3.71E-02	3.42E-02	2.68E-02
Cranium	9.39E-01	8.12E-01	6.45E-01	3.97E-01	1.68E-01	5.47E-02	4.12E-02	4.09E-02	3.70E-02	3.23E-02	2.80E-02	1.87E-02
Eyes	0.00E+00	1.61E-05*	1.08E-04	3.81E-04	5.00E-04	4.30E-04	4.80E-04	5.34E-04	4.71E-04	4.51E-04	4.21E-04	3.56E-04
Lent. Nucl.	0.00E+00	7.78E-05	6.40E-04	1.68E-03	1.52E-03	9.97E-04	9.74E-04	9.53E-04	9.39E-04	8.18E-04	7.79E-04	6.15E-04
Mandible	3.23E-04	1.28E-03	3.28E-03	8.05E-03	1.04E-02	5.92E-03	4.08E-03	3.79E-03	3.66E-03	3.38E-03	3.15E-03	2.66E-03
Other Tissues	9.16E-03	2.31E-02	3.46E-02	4.13E-02	3.48E-02	2.69E-02	2.78E-02	2.97E-02	2.84E-02	2.64E-02	2.46E-02	1.96E-02
Skin	9.62E-03	1.25E-02	1.23E-02	9.49E-03	5.78E-03	4.22E-03	4.86E-03	5.24E-03	4.82E-03	4.24E-03	3.74E-03	2.72E-03
Spinal Col.	2.00E-05	5.70E-05	1.01E-04	1.17E-04	1.38E-04	1.19E-04	1.07E-04	1.17E-04	9.90E-05	1.07E-04	9.84E-05	7.47E-05
Spinal Skel.	5.11E-04	1.69E-03	3.71E-03	7.55E-03	8.41E-03	4.25E-03	2.81E-03	2.60E-03	2.36E-03	2.21E-03	2.04E-03	1.64E-03
Thalami	0.00E+00	3.00E-05	3.53E-04	1.31E-03	1.19E-03	8.39E-04	7.85E-04	7.72E-04	7.42E-04	6.63E-04	5.92E-04	5.15E-04
Thyroid	0.00E+00	0.00E+00	9.73E-07‡	1.16E-05*	3.63E-05	4.26E-05	4.82E-05	5.02E-05	5.80E-05	6.39E-05	5.74E-05	4.58E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	9.47E-05	7.68E-04	1.37E-03	1.70E-03	2.51E-03	3.26E-03	3.53E-03	3.72E-03	3.88E-03
White Matter	5.40E-05	6.54E-03	2.98E-02	6.05E-02	4.62E-02	3.05E-02	3.00E-02	3.06E-02	2.89E-02	2.66E-02	2.46E-02	2.03E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	2.08E-06†	1.41E-06‡	1.06E-05	3.08E-05	7.67E-05	2.37E-03	3.51E-02	8.23E-02	1.31E-01	2.43E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.64E-07‡	2.07E-07‡	1.18E-06*	3.03E-06	4.62E-06	4.74E-06	9.05E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.20E-07‡	3.89E-06	8.38E-06	2.41E-04	4.47E-03	1.06E-02	1.70E-02	3.16E-02
Cereb. Cort.	0.00E+00	0.00E+00	1.27E-06‡	1.41E-06‡	6.06E-06	1.90E-05	4.12E-05	2.03E-03	3.04E-02	7.14E-02	1.14E-01	1.98E-01
Cranium	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.84E-01	9.35E-01	8.33E-01	7.18E-01	6.09E-01	3.72E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-07‡	1.29E-06*	2.23E-06*	4.43E-06	2.49E-05	5.08E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E-08‡	8.40E-07*	2.83E-06	4.58E-06	7.13E-06	1.11E-05	8.24E-05
Mandible	0.00E+00	9.89E-07‡	5.64E-07‡	3.59E-07‡	3.89E-06*	2.10E-05*	7.13E-05	2.61E-04	7.35E-04	1.27E-03	1.84E-03	3.66E-03
Other Tissues	1.85E-05	2.86E-05	5.79E-05	1.08E-04	2.86E-04	9.05E-04	2.82E-03	1.05E-02	2.58E-02	4.15E-02	5.46E-02	7.45E-02
Skin	1.62E-05	4.90E-05	9.05E-05	1.70E-04	4.24E-04	1.41E-03	4.53E-03	1.82E-02	3.32E-02	3.90E-02	4.04E-02	3.16E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-06‡	3.99E-06†	6.29E-06*	3.00E-05	7.95E-05	1.25E-04	1.74E-04	2.60E-04
Spinal Skel.	0.00E+00	1.58E-06‡	3.17E-06*	3.65E-06*	1.10E-05	4 40E-05	1.31E-04	5.33E-04	1.27E-03	2.09E-03	2.96E-03	4.75E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.53E-07‡	5.91E-07‡	1.88E-06*	6.01E-06	7.35E-06	6.70E-06	1.20E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.47E-07‡	1.36E-08‡	1.57E-07*	1.23E-07‡	6.13E-07†	9.74E-07*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-07‡	1.05E-06‡	3.82E-06*	7.08E-06	1.85E-05	2.09E-05	5.11E-05
White Matter	0.00E+00	0.00E+00	8.08E-07‡	0.00E+00	4.08E-06*	7.42E-06	2.49E-05	8.43E-05	1.81E-04	2.70E-04	3.43E-04	1.32E-02

Table A.49: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Lateral Ventricles.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	9.79E-01	7.54E-01	3.78E-01	2.16E-01	2.10E-01	2.11E-01	1.92E-01	1.75E-01	1.59E-01	1.21E-01
Caud. Nucl.	1.88E-03	1.36E-02	2.01E-02	1.50E-02	6.70E-03	3.62E-03	3.58E-03	3.67E-03	3.34E-03	3.08E-03	2.87E-03	2.20E-03
Cerebellum	0.00E+00	6.88E-04	6.43E-03	1.82E-02	1.49E-02	9.05E-03	8.41E-03	8.10E-03	7.34E-03	6.94E-03	6.41E-03	5.11E-03
Cereb. Cort.	2.76E-03	3.68E-02	9.54E-02	1.45E-01	9.48E-02	5.58E-02	5.23E-02	5.18E-02	4.76E-02	4.37E-02	4.07E-02	3.29E-02
Cranium	0.00E+00	2.67E-04	1.47E-02	8.92E-02	8.47E-02	3.30E-02	1.92E-02	1.65E-02	1.51E-02	1.40E-02	1.31E-02	1.08E-02
Eyes	0.00E+00	0.00E+00	3.02E-06†	2.07E-04	4.55E-04	3.88E-04	4.08E-04	4.27E-04	3.68E-04	3.61E-04	3.37E-04	2.71E-04
Lent. Nucl.	1.07E-03	8.47E-03	1.74E-02	1.70E-02	8.63E-03	4.76E-03	4.48E-03	4.45E-03	4.20E-03	3.79E-03	3.52E-03	2.79E-03
Mandible	0.00E+00	0.00E+00	1.35E-04	3.87E-03	9.89E-03	6.31E-03	4.07E-03	3.48E-03	3.24E-03	2.99E-03	2.93E-03	2.42E-03
Other Tissues	0.00E+00	4.68E-06*	9.92E-04	1.59E-02	2.84E-02	2.35E-02	2.25E-02	2.29E-02	2.18E-02	2.02E-02	1.89E-02	1.56E-02
Skin	0.00E+00	0.00E+00	1.96E-04	2.19E-03	3.12E-03	2.50E-03	2.63E-03	2.81E-03	2.63E-03	2.44E-03	2.17E-03	1.83E-03
Spinal Col.	0.00E+00	0.00E+00	3.89E-06†	4.34E-05	1.06E-04	9.21E-05	8.73E-05	8.73E-05	8.03E-05	6.48E-05	7.31E-05	5.35E-05
Spinal Skel.	0.00E+00	0.00E+00	7.50E-05	2.39E-03	5.95E-03	3.60E-03	2.23E-03	1.80E-03	1.60E-03	1.48E-03	1.34E-03	1.16E-03
Thalami	2.18E-03	1.35E-02	2.41E-02	2.09E-02	9.70E-03	5.32E-03	5.10E-03	5.14E-03	4.74E-03	4.32E-03	3.93E-03	3.12E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	9.97E-06	3.59E-05	4.50E-05	4.81E-05	5.14E-05	5.50E-05	6.02E-05	5.72E-05	4.45E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	7.61E-05	9.19E-04	1.56E-03	1.99E-03	3.00E-03	4.00E-03	4.46E-03	4.72E-03	5.10E-03
White Matter	1.44E-01	3.30E-01	4.38E-01	3.81E-01	1.92E-01	1.08E-01	1.04E-01	1.04E-01	9.54E-02	8.73E-02	8.00E-02	6.22E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-09‡	2.31E-06*	5.37E-06	1.31E-05	1.54E-04	1.83E-03	5.37E-03	2.28E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-06‡	1.33E-06†	7.98E-06	1.87E-05	4.32E-05	6.31E-05	7.99E-05	1.39E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	3.63E-06*	4.15E-06*	1.76E-05	4.19E-05	1.38E-04	3.72E-04	2.60E-03	7.63E-03	4.87E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-06‡	1.11E-05	2.92E-05	7.87E-05	1.34E-04	1.87E-04	2.28E-04	3.61E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.87E-07‡	1.06E-07‡	7.97E-07*	1.70E-06	2.63E-06	2.63E-06	5.95E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	9.97E-07‡	1.67E-06†	2.58E-06*	5.33E-06	1.37E-05	2.58E-04	1.38E-03	3.00E-03	1.09E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.93E-07‡	7.15E-07‡	2.60E-06	1.18E-05	2.15E-05	2.67E-05	3.88E-05	6.68E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.07E-09‡	3.73E-06*	1.17E-05	4.08E-05	9.69E-05	1.47E-04	2.00E-04	3.84E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.56E-07‡	2.45E-06*	4.88E-06	1.09E-05	2.02E-05	2.60E-05	4.60E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.11E-08†	6.81E-08‡	3.98E-07*	3.21E-07*	6.08E-07*	1.17E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.32E-07‡	2.05E-06*	7.45E-06	1.18E-05	1.65E-05	1.88E-05	3.70E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E-06‡	3.20E-06	1.36E-05	1.60E-04	1.01E-03	2.77E-03	5.15E-03	1.79E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-07‡	2.34E-07‡	7.24E-08*	3.02E-07*	1.53E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.18E-07‡	2.67E-06	7.64E-06	1.54E-05	2.42E-05	5.63E-05
White Matter	5.60E-05	1.35E-04	2.45E-04	4.83E-04	1.14E-03	3.93E-03	1.22E-02	4.84E-02	1.24E-01	1.99E-01	2.64E-01	4.23E-01

Table A.50: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Lentiform Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.92E-01	9.34E-01	6.76E-01	3.36E-01	1.94E-01	1.89E-01	1.90E-01	1.74E-01	1.57E-01	1.43E-01	1.08E-01
Caud. Nucl.	2.14E-02	4.18E-02	4.07E-02	2.34E-02	9.19E-03	5.12E-03	5.10E-03	5.34E-03	4.91E-03	4.54E-03	4.13E-03	2.91E-03
Cerebellum	0.00E+00	5.01E-05	1.57E-03	8.58E-03	9.20E-03	5.97E-03	5.47E-03	5.37E-03	4.98E-03	4.39E-03	4.12E-03	3.46E-03
Cereb. Cort.	1.32E-03	2.46E-02	7.20E-02	1.12E-01	7.73E-02	4.70E-02	4.37E-02	4.33E-02	3.99E-02	3.68E-02	3.39E-02	2.77E-02
Cranium	1.60E-05*	6.28E-03	4.54E-02	1.21E-01	9.50E-02	3.60E-02	2.13E-02	1.83E-02	1.69E-02	1.56E-02	1.44E-02	1.19E-02
Eyes	0.00E+00	0.00E+00	1.60E-05	3.71E-04	7.59E-04	6.77E-04	6.69E-04	6.65E-04	6.10E-04	5.68E-04	5.38E-04	4.24E-04
Lent. Nucl.	8.42E-01	5.85E-01	3.59E-01	1.44E-01	4.69E-02	2.73E-02	2.93E-02	3.06E-02	2.70E-02	2.28E-02	1.93E-02	1.09E-02
Mandible	0.00E+00	3.49E-05	1.51E-03	1.38E-02	2.20E-02	1.22E-02	7.71E-03	6.62E-03	6.09E-03	5.57E-03	5.32E-03	4.30E-03
Other Tissues	0.00E+00	3.43E-04	7.17E-03	4.01E-02	5.05E-02	3.84E-02	3.69E-02	3.69E-02	3.44E-02	3.18E-02	2.94E-02	2.40E-02
Skin	0.00E+00	0.00E+00	1.88E-04	1.93E-03	2.83E-03	2.43E-03	2.63E-03	2.80E-03	2.57E-03	2.35E-03	2.19E-03	1.79E-03
Spinal Col.	0.00E+00	0.00E+00	5.93E-06*	5.18E-05	1.04E-04	1.00E-04	9.41E-05	7.94E-05	6.94E-05	6.80E-05	6.55E-05	5.09E-05
Spinal Skel.	0.00E+00	0.00E+00	1.21E-04	3.26E-03	7.64E-03	4.52E-03	2.63E-03	1.97E-03	1.80E-03	1.57E-03	1.46E-03	1.18E-03
Thalami	3.17E-02	6.52E-02	6.75E-02	4.02E-02	1.58E-02	8.68E-03	8.85E-03	9.07E-03	8.51E-03	7.56E-03	6.91E-03	5.02E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	2.76E-05	7.73E-05	7.40E-05	8.42E-05	7.75E-05	8.80E-05	8.63E-05	7.71E-05	6.83E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.88E-04	1.41E-03	2.37E-03	2.82E-03	3.99E-03	4.97E-03	5.35E-03	5.66E-03	5.76E-03
White Matter	1.02E-01	2.66E-01	3.72E-01	3.28E-01	1.67E-01	9.48E-02	9.13E-02	9.07E-02	8.34E-02	7.67E-02	7.05E-02	5.53E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.84E-01
Caud. Nucl.	9.65E-06*	1.20E-05*	3.43E-05	7.29E-05	1.85E-04	5.73E-04	1.83E-03	7.43E-03	1.84E-02	2.94E-02	3.88E-02	5.53E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.36E-07‡	5.39E-06	1.11E-05	2.43E-05	3.74E-05	4.83E-05	8.87E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.63E-07‡	4.52E-06*	1.68E-05	3.42E-05	1.07E-04	2.33E-04	9.15E-04	3.21E-03	2.97E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	7.87E-07‡	5.61E-06*	2.01E-05	3.44E-05	8.58E-05	1.63E-04	2.21E-04	2.67E-04	1.59E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-07‡	1.61E-06*	2.51E-06	5.17E-06	4.55E-06	1.14E-05
Lent. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.96E-01	9.86E-01	9.46E-01	8.64E-01	7.80E-01	7.01E-01	4.55E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E-06†	3.51E-06*	5.80E-06	2.31E-05	4.51E-05	6.08E-05	7.78E-05	1.35E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.55E-07‡	5.32E-06	2.00E-05	7.64E-05	1.61E-04	2.59E-04	3.23E-04	6.67E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E-07‡	1.55E-06*	5.53E-06	1.15E-05	1.72E-05	1.95E-05	4.56E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.72E-07‡	2.06E-07*	2.17E-07*	7.93E-07*	2.20E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.67E-07‡	3.04E-06	7.12E-06	1.50E-05	1.86E-05	2.56E-05	4.33E-05
Thalami	1.49E-05	3.20E-05	4.22E-05	1.23E-04	2.83E-04	8.99E-04	2.80E-03	1.11E-02	2.73E-02	4.34E-02	5.75E-02	8.78E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E-08‡	2.41E-07*	3.28E-07*	5.35E-07*	1.30E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.14E-07‡	3.86E-06	1.27E-05	2.09E-05	3.46E-05	7.41E-05
White Matter	2.98E-05	1.02E-04	1.53E-04	3.61E-04	8.64E-04	2.76E-03	8.61E-03	3.44E-02	8.64E-02	1.40E-01	1.90E-01	3.44E-01

Table A.51: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Spinal CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	2.96E-04	3.37E-03	1.64E-02	2.79E-02	2.51E-02	2.49E-02	2.54E-02	2.41E-02	2.26E-02	2.12E-02	1.78E-02
Caud. Nucl.	0.00E+00	0.00E+00	1.92E-06‡	4.95E-05	1.78E-04	1.56E-04	1.57E-04	1.60E-04	1.34E-04	1.33E-04	1.23E-04	1.06E-04
Cerebellum	0.00E+00	5.50E-05	7.77E-04	3.64E-03	5.12E-03	4.33E-03	4.40E-03	4.40E-03	4.15E-03	3.89E-03	3.70E-03	3.00E-03
Cereb. Cort.	0.00E+00	2.20E-04	1.91E-03	7.19E-03	1.11E-02	1.01E-02	1.02E-02	1.03E-02	9.97E-03	9.34E-03	8.72E-03	7.33E-03
Cranium	4.65E-03	1.22E-02	1.81E-02	2.45E-02	2.64E-02	1.34E-02	8.75E-03	7.84E-03	7.27E-03	6.77E-03	6.35E-03	5.25E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	1.01E-06‡	3.93E-05	6.96E-05	9.36E-05	1.08E-04	1.22E-04	9.20E-05	9.90E-05	8.62E-05
Lent. Nucl.	0.00E+00	0.00E+00	9.07E-06	1.78E-04	4.58E-04	4.40E-04	3.98E-04	3.79E-04	3.78E-04	3.47E-04	3.26E-04	2.62E-04
Mandible	0.00E+00	0.00E+00	3.95E-05	3.42E-03	1.17E-02	7.78E-03	5.00E-03	4.40E-03	4.13E-03	3.84E-03	3.59E-03	3.06E-03
Other Tissues	3.35E-08‡	1.42E-04	8.91E-03	8.29E-02	1.08E-01	8.36E-02	8.38E-02	8.58E-02	8.03E-02	7.46E-02	6.95E-02	5.65E-02
Skin	0.00E+00	0.00E+00	1.26E-04	1.75E-03	2.63E-03	2.32E-03	2.54E-03	2.83E-03	2.66E-03	2.38E-03	2.19E-03	1.77E-03
Spinal Col.	9.27E-02	1.16E-01	8.10E-02	3.43E-02	1.15E-02	6.79E-03	7.34E-03	7.96E-03	7.31E-03	6.53E-03	5.73E-03	3.33E-03
Spinal Skel.	1.85E-01	4.36E-01	6.20E-01	6.02E-01	2.92E-01	9.47E-02	6.66E-02	6.45E-02	5.89E-02	5.40E-02	4.92E-02	3.69E-02
Thalami	0.00E+00	1.12E-08‡	2.51E-05	2.81E-04	5.70E-04	5.12E-04	4.64E-04	4.51E-04	4.28E-04	4.00E-04	3.88E-04	2.91E-04
Thyroid	0.00E+00	0.00E+00	5.23E-05	7.20E-04	8.98E-04	6.49E-04	6.17E-04	6.32E-04	5.74E-04	5.40E-04	4.91E-04	4.12E-04
Trunk	4.58E-03	1.21E-02	2.07E-02	4.01E-02	5.52E-02	4.95E-02	4.96E-02	5.38E-02	5.44E-02	5.26E-02	5.04E-02	4.44E-02
White Matter	0.00E+00	2.10E-05	6.39E-04	4.93E-03	1.01E-02	9.25E-03	9.00E-03	9.32E-03	8.69E-03	8.19E-03	7.70E-03	6.53E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E-06‡	2.41E-06*	8.90E-06	4.38E-05	1.09E-04	1.76E-04	2.92E-04	4.56E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-07‡	1.00E-06*	1.04E-06	1.39E-06	3.19E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.23E-07‡	4.15E-07‡	1.15E-06*	8.02E-06	2.01E-05	2.97E-05	5.49E-05	8.52E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-09‡	9.12E-07‡	4.76E-06*	1.92E-05	4.30E-05	7.07E-05	1.41E-04	3.50E-03
Cranium	3.15E-06*	4.45E-06†	5.86E-06*	1.78E-05	4.12E-05	1.35E-04	4.01E-04	1.63E-03	4.09E-03	6.87E-03	9.41E-03	1.39E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-07‡	1.20E-07*	7.33E-07*	1.49E-06	1.83E-06*
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E-07‡	3.99E-07	2.21E-06	2.40E-06	3.89E-06	6.87E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.04E-07‡	1.67E-07‡	6.34E-06	1.25E-05	2.67E-05	3.85E-05	4.64E-05	8.80E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E-06†	1.36E-05	3.73E-05	1.66E-04	3.95E-04	6.13E-04	8.34E-04	7.46E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.99E-07‡	9.22E-08‡	1.00E-06‡	5.43E-06	1.25E-05	1.64E-05	2.48E-05	4.64E-05
Spinal Col.	4.63E-05	8.99E-05	1.72E-04	3.16E-04	8.43E-04	2.75E-03	8.56E-03	3.45E-02	8.78E-02	1.38E-01	1.61E-01	1.16E-01
Spinal Skel.	7.85E-05	1.72E-04	3.15E-04	6.03E-04	1.41E-03	4.93E-03	1.54E-02	6.07E-02	1.57E-01	2.56E-01	3.30E-01	5.15E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.52E-08‡	8.03E-07†	2.13E-06	3.08E-06	4.25E-06	8.00E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-07‡	2.56E-07‡	1.24E-06	3.56E-06	4.68E-06	5.85E-06	1.18E-05
Trunk	2.70E-06†	3.91E-06†	9.33E-06*	1.49E-05	3.38E-05	1.26E-04	4.21E-04	1.63E-03	4.18E-03	7.09E-03	9.95E-03	2.05E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-06‡	1.08E-06†	2.62E-06	1.42E-05	3.96E-05	6.63E-05	8.32E-05	1.82E-04

Table A.52: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Spinal Skeleton.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	1.07E-04	1.60E-03	1.26E-02	2.63E-02	2.44E-02	2.43E-02	2.50E-02	2.41E-02	2.23E-02	2.11E-02	1.77E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	4.32E-05	1.57E-04	1.54E-04	1.61E-04	1.50E-04	1.54E-04	1.33E-04	1.04E-04	1.08E-04
Cerebellum	0.00E+00	2.90E-05	4.17E-04	2.81E-03	4.99E-03	4.23E-03	4.30E-03	4.41E-03	4.24E-03	3.89E-03	3.70E-03	3.08E-03
Cereb. Cort.	0.00E+00	6.71E-05	8.61E-04	5.32E-03	1.04E-02	9.67E-03	9.81E-03	1.02E-02	9.89E-03	9.21E-03	8.68E-03	7.28E-03
Cranium	1.29E-03	4.36E-03	9.43E-03	2.07E-02	2.52E-02	1.29E-02	8.55E-03	7.72E-03	7.34E-03	6.76E-03	6.37E-03	5.37E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	2.15E-06‡	3.86E-05	7.65E-05	9.78E-05	1.07E-04	1.16E-04	9.97E-05	1.13E-04	8.41E-05
Lent. Nucl.	0.00E+00	0.00E+00	6.94E-06*	1.54E-04	4.14E-04	4.28E-04	3.95E-04	3.97E-04	3.62E-04	3.51E-04	3.14E-04	2.76E-04
Mandible	0.00E+00	0.00E+00	1.92E-04	4.32E-03	1.19E-02	7.77E-03	5.09E-03	4.41E-03	4.10E-03	3.88E-03	3.64E-03	2.96E-03
Other Tissues	1.36E-02	4.17E-02	7.89E-02	1.31E-01	1.20E-01	9.00E-02	9.10E-02	9.42E-02	8.78E-02	8.18E-02	7.56E-02	6.13E-02
Skin	3.00E-06‡	2.08E-04	9.67E-04	2.55E-03	2.81E-03	2.36E-03	2.63E-03	2.91E-03	2.72E-03	2.48E-03	2.28E-03	1.87E-03
Spinal Col.	3.92E-04	3.46E-03	6.33E-03	6.48E-03	3.77E-03	2.49E-03	2.63E-03	2.70E-03	2.44E-03	2.32E-03	2.18E-03	1.65E-03
Spinal Skel.	9.76E-01	9.27E-01	8.49E-01	6.32E-01	2.95E-01	9.80E-02	7.20E-02	7.03E-02	6.37E-02	5.61E-02	5.00E-02	3.47E-02
Thalami	0.00E+00	0.00E+00	6.14E-06†	2.17E-04	5.48E-04	4.64E-04	4.44E-04	4.41E-04	3.85E-04	3.69E-04	3.60E-04	2.86E-04
Thyroid	0.00E+00	2.50E-05*	2.38E-04	8.34E-04	9.36E-04	6.35E-04	6.29E-04	6.63E-04	6.20E-04	5.45E-04	4.99E-04	4.08E-04
Trunk	1.17E-03	4.40E-03	1.12E-02	3.15E-02	4.99E-02	4.57E-02	4.62E-02	5.05E-02	5.12E-02	4.94E-02	4.80E-02	4.15E-02
White Matter	0.00E+00	1.10E-05*	2.99E-04	3.91E-03	9.36E-03	9.10E-03	8.86E-03	9.07E-03	8.74E-03	8.06E-03	7.68E-03	6.40E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.23E-07‡	1.82E-06†	1.48E-05	5.90E-05	1.21E-04	2.00E-04	3.11E-04	3.91E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.21E-07‡	3.92E-07†	1.23E-06*	1.82E-06†	2.64E-06	3.75E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E-07‡	2.80E-06	8.93E-06	2.16E-05	3.70E-05	6.43E-05	1.17E-03
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.23E-07‡	2.79E-07†	6.24E-06	2.32E-05	4.74E-05	8.23E-05	1.35E-04	2.52E-03
Cranium	9.00E-07‡	3.39E-06*	1.21E-05	9.48E-06	2.76E-05	1.06E-04	3.14E-04	1.21E-03	3.22E-03	5.69E-03	7.71E-03	1.24E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.52E-07†	8.47E-07‡	8.54E-07*	6.85E-07*	2.42E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.53E-08‡	7.13E-07	1.72E-06	3.04E-06	4.80E-06	9.24E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-06*	4.66E-06	1.39E-05	3.11E-05	4.79E-05	5.51E-05	9.69E-05
Other Tissues	2.45E-05	4.05E-05	7.12E-05	1.54E-04	3.63E-04	1.15E-03	3.69E-03	1.44E-02	3.66E-02	6.13E-02	8.73E-02	1.82E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.71E-07‡	2.11E-06*	6.94E-06	1.30E-05	2.34E-05	2.60E-05	4.51E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.16E-07†	2.15E-06	7.93E-06	1.70E-05	6.91E-04	3.81E-03	1.95E-02
Spinal Skel.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.73E-01	9.32E-01	8.85E-01	8.38E-01	6.67E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-07‡	7.27E-07*	1.63E-06	2.90E-06	4.39E-06	8.53E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-08‡	1.59E-06†	1.88E-06*	2.93E-06	4.64E-06	6.66E-06	1.32E-05
Trunk	2.12E-06‡	3.74E-06†	5.74E-06*	8.96E-06*	2.73E-05	1.19E-04	3.13E-04	1.30E-03	3.34E-03	5.57E-03	8.03E-03	1.78E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-06‡	4.75E-06	2.43E-05	4.49E-05	6.93E-05	9.66E-05	1.87E-04

Table A.53: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Thalami.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.97E-01	9.56E-01	7.11E-01	3.57E-01	2.06E-01	1.99E-01	2.00E-01	1.83E-01	1.65E-01	1.50E-01	1.14E-01
Caud. Nucl.	2.75E-03	1.26E-02	1.76E-02	1.32E-02	5.98E-03	3.36E-03	3.32E-03	3.24E-03	3.00E-03	2.70E-03	2.59E-03	1.94E-03
Cerebellum	0.00E+00	2.19E-04	4.70E-03	1.73E-02	1.48E-02	9.17E-03	8.33E-03	8.09E-03	7.38E-03	6.73E-03	6.35E-03	5.15E-03
Cereb. Cort.	5.19E-05	1.10E-02	5.66E-02	1.10E-01	7.93E-02	4.78E-02	4.42E-02	4.34E-02	4.01E-02	3.65E-02	3.40E-02	2.77E-02
Cranium	0.00E+00	2.49E-03	3.04E-02	1.08E-01	9.26E-02	3.58E-02	2.08E-02	1.77E-02	1.61E-02	1.48E-02	1.38E-02	1.15E-02
Eyes	0.00E+00	0.00E+00	2.86E-06†	1.39E-04	4.58E-04	4.56E-04	4.61E-04	5.06E-04	4.52E-04	4.18E-04	3.87E-04	2.86E-04
Lent. Nucl.	3.80E-02	7.90E-02	8.12E-02	4.82E-02	1.92E-02	1.06E-02	1.06E-02	1.10E-02	1.02E-02	9.21E-03	8.35E-03	6.06E-03
Mandible	0.00E+00	5.92E-06†	6.75E-04	1.05E-02	1.98E-02	1.10E-02	6.82E-03	5.76E-03	5.30E-03	4.97E-03	4.53E-03	3.77E-03
Other Tissues	0.00E+00	1.80E-04	6.36E-03	4.32E-02	5.52E-02	4.13E-02	3.94E-02	3.90E-02	3.65E-02	3.36E-02	3.12E-02	2.58E-02
Skin	0.00E+00	0.00E+00	1.17E-04	1.64E-03	2.80E-03	2.40E-03	2.50E-03	2.71E-03	2.53E-03	2.34E-03	2.15E-03	1.79E-03
Spinal Col.	0.00E+00	0.00E+00	5.05E-06*	1.00E-04	1.90E-04	1.39E-04	1.41E-04	1.18E-04	1.26E-04	1.05E-04	9.22E-05	7.66E-05
Spinal Skel.	0.00E+00	9.78E-07‡	3.99E-04	6.10E-03	1.13E-02	6.22E-03	3.60E-03	2.73E-03	2.47E-03	2.15E-03	2.08E-03	1.65E-03
Thalami	8.62E-01	6.10E-01	3.80E-01	1.54E-01	4.99E-02	2.88E-02	3.10E-02	3.28E-02	2.89E-02	2.47E-02	2.07E-02	1.17E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	4.51E-05	8.45E-05	8.38E-05	8.29E-05	8.40E-05	9.42E-05	9.83E-05	8.61E-05	6.51E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	2.37E-04	1.70E-03	2.77E-03	3.38E-03	4.62E-03	5.71E-03	6.40E-03	6.81E-03	6.79E-03
White Matter	9.17E-02	2.55E-01	3.72E-01	3.35E-01	1.73E-01	9.78E-02	9.34E-02	9.37E-02	8.57E-02	7.81E-02	7.21E-02	5.64E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.68E-07‡	1.22E-06*	4.34E-06	9.78E-05	1.20E-03	3.65E-03	7.00E-03	1.89E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.62E-07‡	1.70E-06†	7.73E-06	2.15E-05	4.19E-05	6.63E-05	7.33E-05	1.36E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.29E-06	1.38E-05	3.81E-05	1.16E-04	2.22E-04	3.36E-04	4.22E-04	5.73E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-06†	1.93E-05	3.29E-05	8.62E-05	1.60E-04	2.06E-04	2.52E-04	4.02E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.11E-08‡	6.79E-07*	2.42E-06*	2.10E-06	3.20E-06	6.18E-06
Lent. Nucl.	1.95E-05*	3.74E-05	5.14E-05	1.20E-04	3.19E-04	1.03E-03	3.34E-03	1.33E-02	3.28E-02	5.26E-02	6.93E-02	1.06E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E-06*	8.42E-06	1.92E-05	3.77E-05	5.02E-05	6.59E-05	1.13E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-07‡	5.14E-06*	2.29E-05	7.85E-05	1.65E-04	2.61E-04	3.51E-04	6.57E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.50E-07‡	1.19E-06*	4.26E-06	9.27E-06	1.87E-05	2.25E-05	4.57E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-07†	1.12E-06*	8.51E-07*	1.74E-06	1.66E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-06†	2.27E-06*	1.27E-05	1.81E-05	3.04E-05	3.50E-05	5.51E-05
Thalami	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.89E-01	9.55E-01	8.84E-01	8.07E-01	7.30E-01	4.77E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.51E-08‡	1.05E-07†	4.31E-07†	5.02E-07*	5.66E-07*	1.60E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.43E-07‡	4.67E-06	1.14E-05	2.85E-05	3.78E-05	8.05E-05
White Matter	3.89E-05	7.21E-05	1.24E-04	2.88E-04	7.35E-04	2.31E-03	7.39E-03	2.95E-02	7.62E-02	1.23E-01	1.70E-01	3.35E-01

Table A.54: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Third Ventricle.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.99E-01	9.68E-01	7.36E-01	3.72E-01	2.13E-01	2.06E-01	2.07E-01	1.88E-01	1.71E-01	1.56E-01	1.18E-01
Caud. Nucl.	8.98E-06*	2.72E-03	9.58E-03	1.08E-02	5.31E-03	2.93E-03	2.71E-03	2.77E-03	2.49E-03	2.32E-03	2.16E-03	1.72E-03
Cerebellum	0.00E+00	2.41E-04	5.18E-03	1.83E-02	1.54E-02	9.56E-03	8.70E-03	8.38E-03	7.76E-03	7.06E-03	6.49E-03	5.36E-03
Cereb. Cort.	1.00E-06‡	6.13E-03	4.69E-02	1.07E-01	8.05E-02	4.84E-02	4.45E-02	4.34E-02	4.00E-02	3.67E-02	3.39E-02	2.77E-02
Cranium	0.00E+00	1.05E-03	2.16E-02	9.69E-02	8.98E-02	3.50E-02	2.02E-02	1.70E-02	1.55E-02	1.43E-02	1.35E-02	1.11E-02
Eyes	0.00E+00	0.00E+00	2.91E-06†	2.04E-04	4.43E-04	4.64E-04	4.57E-04	4.55E-04	4.33E-04	4.09E-04	3.87E-04	2.99E-04
Lent. Nucl.	2.50E-04	1.41E-02	3.39E-02	3.05E-02	1.39E-02	7.44E-03	7.34E-03	7.40E-03	6.77E-03	6.31E-03	5.68E-03	4.64E-03
Mandible	0.00E+00	1.00E-06‡	3.77E-04	8.40E-03	1.72E-02	1.00E-02	6.17E-03	5.28E-03	4.92E-03	4.41E-03	4.18E-03	3.53E-03
Other Tissues	0.00E+00	6.69E-05	4.30E-03	3.55E-02	4.91E-02	3.75E-02	3.53E-02	3.55E-02	3.29E-02	3.04E-02	2.86E-02	2.35E-02
Skin	0.00E+00	0.00E+00	8.62E-05	1.61E-03	2.80E-03	2.40E-03	2.57E-03	2.69E-03	2.49E-03	2.27E-03	2.12E-03	1.77E-03
Spinal Col.	0.00E+00	0.00E+00	1.08E-05*	1.11E-04	1.61E-04	1.48E-04	1.37E-04	1.23E-04	9.99E-05	1.09E-04	9.23E-05	7.14E-05
Spinal Skel.	0.00E+00	0.00E+00	3.15E-04	5.47E-03	1.04E-02	5.86E-03	3.44E-03	2.65E-03	2.34E-03	2.17E-03	1.97E-03	1.56E-03
Thalami	4.02E-02	1.62E-01	1.66E-01	8.91E-02	3.19E-02	1.76E-02	1.84E-02	1.92E-02	1.77E-02	1.62E-02	1.50E-02	1.06E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	2.70E-05	7.77E-05	7.64E-05	7.22E-05	8.38E-05	7.53E-05	7.70E-05	8.21E-05	6.38E-05
Trunk	0.00E+00	0.00E+00	9.84E-07‡	1.82E-04	1.53E-03	2.56E-03	3.11E-03	4.27E-03	5.39E-03	6.05E-03	6.60E-03	6.66E-03
White Matter	3.50E-01	4.83E-01	5.03E-01	3.90E-01	1.93E-01	1.09E-01	1.05E-01	1.06E-01	9.68E-02	8.80E-02	8.05E-02	6.03E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	6.56E-07‡	4.16E-07‡	9.85E-07*	3.34E-06	9.68E-06	1.57E-05	2.41E-05	3.01E-05	2.29E-04
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-07‡	2.48E-06*	7.64E-06	2.32E-05	4.68E-05	6.43E-05	8.54E-05	1.45E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.29E-07‡	3.84E-06*	1.24E-05	3.60E-05	1.18E-04	2.27E-04	3.29E-04	4.24E-04	1.10E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-06†	1.22E-05	3.34E-05	8.12E-05	1.48E-04	1.96E-04	2.40E-04	3.81E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.34E-07‡	1.20E-06†	1.63E-06	2.05E-06	2.91E-06	7.65E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.21E-06†	5.53E-06*	8.69E-06	2.53E-05	4.39E-05	6.36E-05	1.26E-04	1.41E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.43E-07†	6.59E-06	1.81E-05	3.15E-05	4.63E-05	5.89E-05	9.95E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.31E-07‡	5.92E-06	1.96E-05	8.11E-05	1.58E-04	2.46E-04	3.17E-04	5.79E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-07‡	6.37E-07†	5.22E-06	1.06E-05	1.60E-05	2.42E-05	4.10E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E-09‡	1.47E-07‡	3.43E-07†	9.70E-07	1.10E-06*	1.81E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-06*	4.17E-06*	9.80E-06	1.72E-05	2.51E-05	3.05E-05	4.86E-05
Thalami	0.00E+00	0.00E+00	3.45E-06†	3.08E-06*	7.52E-06	1.74E-05	3.51E-05	8.57E-05	8.14E-03	5.36E-02	1.22E-01	2.61E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.78E-07‡	2.28E-07‡	4.01E-07*	7.30E-07*	5.74E-07*	2.06E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.88E-07‡	8.34E-07‡	4.76E-06*	1.44E-05	2.71E-05	3.23E-05	8.68E-05
White Matter	2.01E-04	4.30E-04	7.74E-04	1.50E-03	3.73E-03	1.24E-02	3.91E-02	1.54E-01	3.70E-01	4.97E-01	5.28E-01	4.99E-01

Table A.55: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the Thyroid.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	2.50E-05	2.18E-03	7.39E-03	8.04E-03	8.48E-03	9.53E-03	9.70E-03	9.50E-03	8.98E-03	7.88E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	1.29E-05*	6.47E-05	7.80E-05	7.68E-05	7.39E-05	8.52E-05	7.79E-05	6.64E-05	6.62E-05
Cerebellum	0.00E+00	0.00E+00	0.00E+00	8.52E-05	6.20E-04	7.83E-04	8.60E-04	9.68E-04	1.00E-03	9.91E-04	8.98E-04	8.44E-04
Cereb. Cort.	0.00E+00	0.00E+00	1.59E-05	9.55E-04	3.01E-03	3.21E-03	3.45E-03	3.92E-03	3.98E-03	3.94E-03	3.75E-03	3.31E-03
Cranium	0.00E+00	1.00E-06‡	1.11E-04	2.51E-03	6.11E-03	4.00E-03	2.65E-03	2.51E-03	2.49E-03	2.47E-03	2.29E-03	2.09E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	9.27E-07‡	2.40E-05	6.17E-05	7.39E-05	8.85E-05	1.02E-04	9.57E-05	9.17E-05	8.43E-05
Lent. Nucl.	0.00E+00	0.00E+00	9.99E-07‡	6.97E-05	1.97E-04	1.97E-04	1.80E-04	1.96E-04	2.11E-04	1.97E-04	1.84E-04	1.39E-04
Mandible	0.00E+00	4.19E-05	1.52E-03	1.16E-02	1.55E-02	7.59E-03	4.67E-03	3.87E-03	3.56E-03	3.27E-03	3.07E-03	2.55E-03
Other Tissues	1.93E-01	4.25E-01	4.90E-01	3.57E-01	1.70E-01	1.02E-01	1.03E-01	1.08E-01	1.01E-01	9.27E-02	8.55E-02	6.62E-02
Skin	2.10E-05	2.23E-03	5.68E-03	5.84E-03	3.36E-03	2.21E-03	2.35E-03	2.52E-03	2.36E-03	2.14E-03	1.95E-03	1.60E-03
Spinal Col.	0.00E+00	0.00E+00	4.10E-05	4.91E-04	6.03E-04	4.74E-04	4.82E-04	4.76E-04	4.61E-04	3.98E-04	3.76E-04	3.19E-04
Spinal Skel.	0.00E+00	1.70E-03	1.58E-02	5.16E-02	4.75E-02	1.89E-02	1.21E-02	1.09E-02	9.98E-03	9.21E-03	8.54E-03	6.99E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	6.13E-05	1.75E-04	1.81E-04	1.60E-04	1.80E-04	1.64E-04	1.73E-04	1.71E-04	1.40E-04
Thyroid	7.99E-01	5.13E-01	3.01E-01	1.15E-01	3.61E-02	2.09E-02	2.31E-02	2.46E-02	2.10E-02	1.76E-02	1.46E-02	7.59E-03
Trunk	7.43E-03	4.23E-02	1.01E-01	1.74E-01	1.58E-01	1.12E-01	1.07E-01	1.12E-01	1.08E-01	1.03E-01	9.73E-02	8.23E-02
White Matter	0.00E+00	0.00E+00	8.06E-06*	9.61E-04	3.20E-03	3.46E-03	3.61E-03	4.03E-03	4.10E-03	3.97E-03	3.75E-03	3.25E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-07‡	4.53E-06	1.44E-05	3.23E-05	5.31E-05	7.77E-05	1.50E-04
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.43E-09‡	1.00E-07‡	4.27E-07*	4.18E-07†	4.74E-07*	6.96E-07
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-07†	1.93E-06*	3.07E-06	5.87E-06	9.08E-06	1.48E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.88E-08‡	1.88E-06*	5.36E-06	1.50E-05	2.30E-05	3.02E-05	6.23E-05
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.28E-07†	2.64E-06*	6.71E-06	1.39E-05	1.75E-05	2.53E-05	4.80E-05
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-07‡	1.12E-07*	3.22E-07‡	6.90E-07*	1.54E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E-09‡	2.58E-07‡	5.18E-07	1.16E-06	3.06E-06*	4.60E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.25E-07‡	1.18E-06*	4.80E-06*	1.59E-05	2.54E-05	3.67E-05	4.51E-05	7.54E-05
Other Tissues	9.21E-05	1.94E-04	3.31E-04	6.73E-04	1.66E-03	5.44E-03	1.72E-02	6.67E-02	1.66E-01	2.65E-01	3.53E-01	5.60E-01
Skin	0.00E+00	0.00E+00	0.00E+00	4.78E-07‡	0.00E+00	7.39E-07‡	2.56E-06*	6.24E-06	1.28E-05	1.92E-05	2.49E-05	2.02E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.34E-08‡	1.68E-07‡	9.38E-07*	2.76E-06	3.69E-06	5.06E-06	6.25E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	6.83E-07‡	1.71E-06‡	6.19E-06	1.41E-05	4.50E-05	7.82E-05	1.13E-04	1.35E-04	2.30E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-07‡	3.48E-07*	3.44E-07	7.85E-07	1.69E-06	2.25E-06
Thyroid	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.82E-01	9.31E-01	8.25E-01	7.18E-01	6.21E-01	3.63E-01
Trunk	0.00E+00	6.58E-07‡	0.00E+00	2.45E-06†	9.83E-06	5.00E-05	2.05E-04	1.28E-03	4.94E-03	1.07E-02	1.74E-02	5.43E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.18E-08‡	2.09E-06*	6.10E-06	1.25E-05	2.13E-05	3.23E-05	6.28E-05

Table A.56: Absorbed Fractions for the 10-year-old Phantom for Sources Located in the White Matter.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.82E-01	8.99E-01	6.24E-01	3.01E-01	1.75E-01	1.73E-01	1.75E-01	1.61E-01	1.45E-01	1.32E-01	9.89E-02
Caud. Nucl.	2.76E-03	6.69E-03	8.88E-03	7.06E-03	3.45E-03	1.98E-03	1.86E-03	1.98E-03	1.74E-03	1.62E-03	1.48E-03	1.11E-03
Cerebellum	2.20E-05	2.00E-03	8.77E-03	1.64E-02	1.21E-02	7.40E-03	6.94E-03	6.99E-03	6.47E-03	5.91E-03	5.47E-03	4.48E-03
Cereb. Cort.	4.80E-02	1.30E-01	1.83E-01	1.70E-01	9.36E-02	5.53E-02	5.37E-02	5.43E-02	5.01E-02	4.64E-02	4.30E-02	3.37E-02
Cranium	1.31E-04	1.55E-02	7.17E-02	1.44E-01	9.82E-02	3.51E-02	2.19E-02	1.96E-02	1.81E-02	1.66E-02	1.57E-02	1.28E-02
Eyes	0.00E+00	1.05E-06‡	5.31E-05	4.20E-04	5.98E-04	5.13E-04	5.48E-04	5.62E-04	4.94E-04	4.63E-04	4.50E-04	3.75E-04
Lent. Nucl.	3.46E-03	8.92E-03	1.24E-02	1.09E-02	5.65E-03	3.17E-03	3.09E-03	3.07E-03	2.80E-03	2.53E-03	2.40E-03	1.82E-03
Mandible	0.00E+00	1.50E-05*	5.08E-04	5.47E-03	1.09E-02	6.56E-03	4.33E-03	3.73E-03	3.61E-03	3.35E-03	3.20E-03	2.74E-03
Other Tissues	0.00E+00	1.96E-04	3.88E-03	2.21E-02	3.02E-02	2.42E-02	2.35E-02	2.42E-02	2.35E-02	2.17E-02	2.01E-02	1.66E-02
Skin	0.00E+00	5.56E-05	8.57E-04	3.62E-03	3.58E-03	2.79E-03	2.95E-03	3.19E-03	2.95E-03	2.68E-03	2.50E-03	2.03E-03
Spinal Col.	0.00E+00	0.00E+00	8.10E-06*	5.94E-05	8.82E-05	8.73E-05	8.52E-05	7.52E-05	7.16E-05	6.35E-05	6.77E-05	5.07E-05
Spinal Skel.	0.00E+00	3.99E-06‡	2.74E-04	2.96E-03	5.97E-03	3.43E-03	2.15E-03	1.79E-03	1.62E-03	1.49E-03	1.36E-03	1.10E-03
Thalami	2.54E-03	6.91E-03	1.01E-02	9.18E-03	4.82E-03	2.70E-03	2.62E-03	2.58E-03	2.34E-03	2.16E-03	1.97E-03	1.59E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.31E-05*	3.74E-05	4.46E-05	4.83E-05	5.21E-05	5.93E-05	6.16E-05	5.44E-05	4.85E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	9.47E-05	8.55E-04	1.51E-03	1.89E-03	2.76E-03	3.54E-03	3.93E-03	4.09E-03	4.40E-03
White Matter	9.37E-01	8.15E-01	6.60E-01	3.96E-01	1.74E-01	1.00E-01	1.01E-01	1.02E-01	9.35E-02	8.37E-02	7.49E-02	5.39E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.74E-01
Caud. Nucl.	2.65E-06†	2.24E-06‡	8.85E-07‡	1.22E-05	2.21E-05	7.80E-05	2.04E-04	8.88E-04	2.29E-03	3.73E-03	5.11E-03	8.68E-03
Cerebellum	0.00E+00	0.00E+00	0.00E+00	6.56E-07‡	6.15E-07‡	1.65E-06‡	4.29E-06	1.89E-05	3.46E-05	5.11E-05	6.52E-05	1.30E-03
Cereb. Cort.	1.45E-05	4.43E-05	5.70E-05	1.42E-04	3.67E-04	1.24E-03	3.88E-03	1.49E-02	3.90E-02	6.53E-02	9.07E-02	1.73E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	1.85E-06†	3.15E-06†	1.59E-05	4.31E-05	9.84E-05	1.70E-04	2.33E-04	2.96E-04	8.38E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.89E-08‡	1.17E-06*	3.04E-06	3.65E-06	3.73E-06	1.10E-05
Lent. Nucl.	8.59E-07‡	1.42E-06‡	3.67E-06*	1.33E-05	2.89E-05	9.56E-05	2.97E-04	1.15E-03	2.87E-03	4.69E-03	6.47E-03	1.15E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-06*	4.05E-06	1.01E-05	2.22E-05	3.12E-05	4.08E-05	8.95E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.20E-06*	1.26E-05	4.50E-05	9.79E-05	1.61E-04	2.09E-04	5.66E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.80E-07‡	7.69E-07*	6.17E-06	1.29E-05	2.00E-05	2.65E-05	9.06E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E-08‡	1.01E-07‡	3.88E-07†	3.68E-07*	5.91E-07*	1.49E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	6.88E-07‡	8.64E-07‡	1.06E-06‡	1.41E-06*	6.51E-06	1.27E-05	1.52E-05	2.18E-05	3.66E-05
Thalami	0.00E+00	2.98E-06*	3.97E-06*	1.01E-05*	2.62E-05	6.45E-05	2.13E-04	8.65E-04	2.16E-03	3.44E-03	4.81E-03	9.27E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.74E-08‡	1.79E-07†	3.82E-07*	4.29E-07*	6.17E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.08E-07†	2.70E-06	9.65E-06	1.43E-05	1.83E-05	4.92E-05
White Matter	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.79E-01	9.45E-01	9.10E-01	8.75E-01	7.54E-01

Absorbed Fractions of Energy in a Mathematical Model of the Head and Brain of a Fifteen-Year-Old

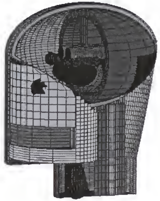


Table A.57: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Brain (Total).

Targets	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.75E-01	9.15E-01	8.11E-01	5.55E-01	2.72E-01	1.59E-01	1.57E-01	1.60E-01	1.47E-01	1.33E-01	1.21E-01	9.07E-02
Caud. Nucl.	7.50E-03	7.50E-03	7.11E-03	5.39E-03	2.69E-03	1.53E-03	1.51E-03	1.52E-03	1.39E-03	1.24E-03	1.14E-03	8.68E-04
Cerebellum	9.59E-02	8.88E-02	7.66E-02	5.04E-02	2.46E-02	1.43E-02	1.43E-02	1.47E-02	1.34E-02	1.21E-02	1.11E-02	8.29E-03
Cereb. Cort.	4.14E-01	3.71E-01	3.14E-01	2.09E-01	1.02E-01	6.05E-02	6.04E-02	6.21E-02	5.73E-02	5.15E-02	4.67E-02	3.49E-02
Cranium	1.43E-02	6.95E-02	1.44E-01	1.98E-01	1.20E-01	4.22E-02	2.70E-02	2.48E-02	2.29E-02	2.10E-02	1.95E-02	1.59E-02
Eyes	0.00E+00	0.00E+00	2.12E-05	2.75E-04	4.36E-04	3.87E-04	4.36E-04	4.60E-04	4.38E-04	3.73E-04	3.62E-04	2.98E-04
Lent. Nucl.	1.39E-02	1.39E-02	1.30E-02	9.53E-03	4.89E-03	2.77E-03	2.69E-03	2.75E-03	2.43E-03	2.23E-03	2.06E-03	1.53E-03
Mandible	0.00E+00	3.09E-05	5.69E-04	4.92E-03	9.97E-03	6.27E-03	4.14E-03	3.57E-03	3.45E-03	3.24E-03	2.97E-03	2.60E-03
Other Tissues	0.00E+00	4.22E-04	5.23E-03	2.43E-02	3.14E-02	2.54E-02	2.53E-02	2.59E-02	2.47E-02	2.30E-02	2.16E-02	1.80E-02
Skin	0.00E+00	2.31E-04	2.21E-03	6.90E-03	6.62E-03	5.07E-03	5.44E-03	5.91E-03	5.59E-03	5.11E-03	4.72E-03	3.84E-03
Spinal Col.	0.00E+00	0.00E+00	9.15E-06	7.54E-05	1.08E-04	1.11E-04	9.57E-05	9.44E-05	9.22E-05	9.67E-05	7.22E-05	7.69E-05
Spinal Skel.	0.00E+00	2.88E-05	4.52E-04	3.91E-03	7.04E-03	3.89E-03	2.54E-03	2.11E-03	1.93E-03	1.84E-03	1.69E-03	1.35E-03
Thalami	1.14E-02	1.16E-02	1.09E-02	8.06E-03	4.17E-03	2.44E-03	2.31E-03	2.28E-03	2.13E-03	1.83E-03	1.71E-03	1.30E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	9.83E-06*	6.36E-05	6.04E-05	6.80E-05	7.45E-05	8.63E-05	6.94E-05	8.97E-05	6.27E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	7.65E-05	8.85E-04	1.80E-03	2.28E-03	3.36E-03	4.52E-03	5.08E-03	5.31E-03	5.70E-03
White Matter	4.17E-01	4.08E-01	3.74E-01	2.61E-01	1.27E-01	7.43E-02	7.28E-02	7.38E-02	6.78E-02	6.11E-02	5.53E-02	4.19E-02

Targets	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.91E-01	9.77E-01	9.62E-01	9.46E-01	8.84E-01
Caud. Nucl.	7.56E-03	7.55E-03	7.49E-03	7.51E-03	7.60E-03	7.58E-03	7.51E-03	7.58E-03	7.51E-03	7.48E-03	7.36E-03	7.39E-03
Cerebellum	9.98E-02	9.95E-02	9.94E-02	9.95E-02	9.99E-02	9.94E-02	9.93E-02	9.90E-02	9.68E-02	9.44E-02	9.24E-02	8.52E-02
Cereb. Cort.	4.36E-01	4.36E-01	4.36E-01	4.37E-01	4.36E-01	4.35E-01	4.34E-01	4.28E-01	4.18E-01	4.05E-01	3.92E-01	3.47E-01
Cranium	0.00E+00	0.00E+00	1.45E-06‡	4.37E-07‡	7.89E-06	2.19E-05	5.75E-05	5.00E-04	8.31E-03	2.03E-02	3.31E-02	6.54E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.08E-07†	6.78E-07*	2.05E-06	2.58E-06	2.67E-06	2.07E-05
Lent. Nucl.	1.41E-02	1.40E-02	1.42E-02	1.41E-02	1.40E-02	1.40E-02	1.42E-02	1.41E-02	1.41E-02	1.42E-02	1.40E-02	1.39E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.27E-07†	3.07E-06*	1.10E-05	2.08E-05	3.17E-05	4.88E-05	3.12E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	5.25E-07‡	6.92E-07‡	5.91E-06	1.15E-05	4.76E-05	1.13E-04	1.74E-04	3.07E-04	5.75E-03
Skin	0.00E+00	0.00E+00	0.00E+00	6.60E-07‡	0.00E+00	5.21E-07†	2.00E-06	1.04E-05	2.42E-05	3.28E-05	9.98E-05	4.85E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.18E-08‡	5.13E-08‡	5.64E-08†	5.61E-07*	4.95E-07	9.79E-07*	1.66E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-06*	2.23E-06*	5.99E-06	1.32E-05	2.26E-05	2.50E-05	3.03E-04
Thalami	1.15E-02	1.14E-02	1.15E-02	1.15E-02	1.15E-02	1.15E-02	1.15E-02	1.15E-02	1.14E-02	1.14E-02	1.12E-02	1.13E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-08†	1.50E-07†	3.73E-07‡	5.15E-07	1.84E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-06†	2.10E-06	9.15E-06	1.61E-05	2.90E-05	6.84E-05
White Matter	4.15E-01	4.16E-01	4.15E-01	4.15E-01	4.15E-01	4.16E-01	4.15E-01	4.15E-01	4.14E-01	4.14E-01	4.13E-01	4.05E-01

Table A.58: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Caudate Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.98E-01	9.60E-01	7.13E-01	3.55E-01	2.05E-01	1.99E-01	2.00E-01	1.83E-01	1.65E-01	1.50E-01	1.14E-01
Caud. Nucl.	8.07E-01	5.05E-01	2.85E-01	1.06E-01	3.32E-02	1.94E-02	2.14E-02	2.26E-02	1.93E-02	1.59E-02	1.28E-02	6.39E-03
Cerebellum	0.00E+00	3.58E-05	1.48E-03	8.26E-03	8.63E-03	5.70E-03	5.20E-03	5.16E-03	4.72E-03	4.32E-03	4.09E-03	3.31E-03
Cereb. Cort.	1.30E-05	7.14E-03	4.93E-02	1.06E-01	7.75E-02	4.71E-02	4.36E-02	4.27E-02	3.96E-02	3.64E-02	3.36E-02	2.75E-02
Cranium	0.00E+00	1.70E-03	2.80E-02	1.12E-01	9.80E-02	3.78E-02	2.25E-02	1.91E-02	1.78E-02	1.61E-02	1.51E-02	1.25E-02
Eyes	0.00E+00	0.00E+00	1.80E-05	4.07E-04	7.39E-04	6.34E-04	6.19E-04	6.30E-04	6.06E-04	5.70E-04	4.94E-04	4.51E-04
Lent. Nucl.	3.75E-02	7.57E-02	7.47E-02	4.37E-02	1.72E-02	9.49E-03	9.69E-03	9.99E-03	9.20E-03	8.27E-03	7.68E-03	5.48E-03
Mandible	0.00E+00	6.98E-06	4.12E-04	6.57E-03	1.37E-02	8.58E-03	5.47E-03	4.77E-03	4.36E-03	4.01E-03	3.80E-03	3.20E-03
Other Tissues	0.00E+00	2.90E-05	1.85E-03	1.98E-02	3.23E-02	2.72E-02	2.64E-02	2.64E-02	2.51E-02	2.33E-02	2.19E-02	1.80E-02
Skin	0.00E+00	3.00E-06‡	3.92E-04	3.62E-03	5.10E-03	4.39E-03	4.54E-03	4.85E-03	4.62E-03	4.27E-03	3.99E-03	3.26E-03
Spinal Col.	0.00E+00	0.00E+00	1.01E-06‡	2.98E-05	7.39E-05	6.67E-05	7.26E-05	6.51E-05	5.30E-05	5.50E-05	4.03E-05	3.84E-05
Spinal Skel.	0.00E+00	0.00E+00	4.48E-05	1.58E-03	4.99E-03	3.29E-03	1.98E-03	1.48E-03	1.27E-03	1.20E-03	1.11E-03	9.40E-04
Thalami	5.11E-03	2.05E-02	2.79E-02	2.10E-02	9.54E-03	5.23E-03	5.16E-03	5.22E-03	4.67E-03	4.35E-03	4.03E-03	3.08E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.81E-05	7.14E-05	7.82E-05	8.22E-05	9.40E-05	9.01E-05	9.36E-05	8.04E-05	7.30E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	1.03E-04	1.04E-03	2.05E-03	2.54E-03	3.74E-03	4.91E-03	5.60E-03	5.88E-03	6.31E-03
White Matter	1.47E-01	3.62E-01	4.80E-01	3.96E-01	1.94E-01	1.10E-01	1.07E-01	1.07E-01	9.82E-02	8.93E-02	8.24E-02	6.36E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.95E-01	9.84E-01	9.37E-01	8.38E-01	7.31E-01	6.29E-01	3.37E-01
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.15E-08‡	3.05E-06*	2.61E-06*	1.07E-05	2.60E-05	3.91E-05	4.64E-05	8.86E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E-06†	1.32E-05	3.49E-05	1.11E-04	2.18E-04	3.24E-04	4.18E-04	1.89E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.19E-06*	1.37E-05	3.78E-05	9.20E-05	1.64E-04	2.18E-04	2.65E-04	4.21E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.65E-07‡	3.20E-07‡	1.83E-06*	2.08E-06	4.98E-06	4.73E-06	1.22E-05
Lent. Nucl.	1.58E-05*	3.91E-05	5.81E-05	1.31E-04	3.48E-04	1.07E-03	3.37E-03	1.30E-02	3.24E-02	5.18E-02	6.85E-02	1.01E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.37E-06†	5.66E-06	1.36E-05	2.51E-05	3.78E-05	5.39E-05	9.20E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.44E-08‡	2.55E-06*	1.29E-05	5.00E-05	1.13E-04	1.80E-04	2.33E-04	4.36E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.70E-07†	2.03E-06	1.05E-05	2.08E-05	2.97E-05	3.77E-05	7.88E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-07‡	4.52E-09‡	2.93E-07‡	3.99E-07†	6.15E-07	6.22E-07	6.66E-07
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-06*	6.38E-06	9.33E-06	1.39E-05	1.76E-05	2.79E-05
Thalami	0.00E+00	0.00E+00	7.63E-07‡	6.40E-07‡	2.34E-06†	4.37E-06*	3.21E-05	4.27E-04	2.64E-03	6.83E-03	1.20E-02	3.08E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.82E-08‡	1.07E-07‡	2.71E-07*	3.62E-07	1.16E-06‡	2.16E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.61E-07†	3.63E-06	1.14E-05	2.04E-05	2.80E-05	7.00E-05
White Matter	6.88E-05	1.32E-04	2.16E-04	4.54E-04	1.14E-03	3.97E-03	1.22E-02	4.82E-02	1.23E-01	2.01E-01	2.72E-01	4.69E-01

Table A.59: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Cerebellum.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.68E-01	8.92E-01	7.71E-01	5.10E-01	2.47E-01	1.45E-01	1.45E-01	1.47E-01	1.36E-01	1.22E-01	1.11E-01	8.23E-02
Caud. Nucl.	0.00E+00	1.95E-06‡	1.09E-04	6.49E-04	6.58E-04	4.62E-04	3.97E-04	3.88E-04	3.52E-04	3.31E-04	2.96E-04	2.53E-04
Cerebellum	9.32E-01	7.87E-01	5.94E-01	3.01E-01	1.14E-01	6.46E-02	6.78E-02	7.05E-02	6.40E-02	5.62E-02	5.00E-02	3.36E-02
Cereb. Cort.	3.57E-02	9.64E-02	1.39E-01	1.32E-01	7.40E-02	4.43E-02	4.32E-02	4.37E-02	4.08E-02	3.76E-02	3.45E-02	2.73E-02
Cranium	1.82E-02	8.87E-02	1.78E-01	2.25E-01	1.28E-01	4.40E-02	2.87E-02	2.64E-02	2.46E-02	2.28E-02	2.09E-02	1.67E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	9.99E-06*	7.02E-05	9.22E-05	1.10E-04	1.17E-04	1.07E-04	1.06E-04	9.64E-05	8.88E-05
Lent. Nucl.	0.00E+00	4.02E-06*	2.40E-04	1.27E-03	1.35E-03	9.06E-04	8.00E-04	7.83E-04	7.12E-04	6.67E-04	6.18E-04	5.06E-04
Mandible	0.00E+00	0.00E+00	1.18E-05	1.26E-03	5.00E-03	3.89E-03	2.66E-03	2.33E-03	2.22E-03	2.08E-03	2.02E-03	1.83E-03
Other Tissues	0.00E+00	7.57E-04	9.35E-03	3.65E-02	4.09E-02	3.17E-02	3.19E-02	3.32E-02	3.18E-02	2.94E-02	2.74E-02	2.26E-02
Skin	0.00E+00	2.27E-04	2.39E-03	7.64E-03	6.71E-03	5.07E-03	5.55E-03	5.96E-03	5.64E-03	5.20E-03	4.73E-03	3.82E-03
Spinal Col.	0.00E+00	0.00E+00	2.26E-05	1.58E-04	2.18E-04	1.56E-04	1.83E-04	1.89E-04	1.93E-04	1.68E-04	1.60E-04	1.30E-04
Spinal Skel.	0.00E+00	5.59E-05	9.84E-04	8.33E-03	1.36E-02	7.22E-03	4.53E-03	4.13E-03	3.83E-03	3.56E-03	3.38E-03	2.83E-03
Thalami	0.00E+00	1.60E-05	5.80E-04	1.97E-03	1.83E-03	1.09E-03	9.63E-04	9.60E-04	8.77E-04	8.25E-04	7.29E-04	6.04E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	7.75E-06*	3.94E-05	6.33E-05	5.84E-05	7.82E-05	7.66E-05	8.78E-05	7.87E-05	7.17E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	5.19E-05	8.55E-04	2.02E-03	2.65E-03	3.98E-03	5.08E-03	5.76E-03	6.21E-03	6.51E-03
White Matter	4.69E-05	8.06E-03	3.64E-02	7.01E-02	5.26E-02	3.22E-02	3.01E-02	2.96E-02	2.76E-02	2.54E-02	2.34E-02	1.92E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.88E-01	9.70E-01	9.51E-01	9.31E-01	8.56E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E-07‡	1.91E-07‡	7.77E-07*	2.66E-06	2.57E-06	3.37E-06	6.94E-06
Cerebellum	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.77E-01	9.41E-01	9.02E-01	8.65E-01	7.23E-01
Cereb. Cort.	1.08E-05*	2.68E-05	6.03E-05	1.24E-04	2.93E-04	9.42E-04	2.84E-03	1.13E-02	2.91E-02	4.84E-02	6.63E-02	1.27E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	2.54E-06†	6.52E-06	2.37E-05	6.31E-05	4.96E-04	1.06E-02	2.63E-02	4.32E-02	8.56E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.47E-09‡	4.86E-08‡	5.40E-07*	4.13E-07	6.24E-07*	1.68E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-07‡	3.93E-07†	1.55E-06	2.81E-06	5.42E-06	8.05E-06	1.35E-05
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.42E-07‡	8.41E-07†	7.53E-06	1.09E-05	1.73E-05	2.09E-05	4.22E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-06‡	3.87E-06	1.56E-05	6.45E-05	1.41E-04	2.24E-04	3.51E-04	1.26E-02
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.03E-08‡	1.59E-06*	3.12E-06	1.10E-05	2.57E-05	3.83E-05	8.09E-05	4.22E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.07E-07*	9.92E-07*	1.01E-06	2.05E-06	1.21E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-08‡	1.41E-06‡	4.18E-06	1.35E-05	2.80E-05	3.62E-05	5.07E-05	7.10E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-08‡	1.27E-06†	1.91E-06	5.58E-06	7.01E-06	8.94E-06	1.71E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.62E-07‡	0.00E+00	4.49E-09‡	7.80E-08*	3.61E-07*	5.20E-07*	1.53E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.04E-07‡	8.44E-07†	3.26E-06*	9.17E-06	1.99E-05	2.88E-05	8.24E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-06†	1.09E-05	2.44E-05	7.58E-05	1.57E-04	2.20E-04	2.84E-04	5.33E-03

Table A.60: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Cerebral Cortex.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.50E-01	8.48E-01	7.20E-01	4.79E-01	2.34E-01	1.39E-01	1.39E-01	1.42E-01	1.31E-01	1.18E-01	1.07E-01	8.01E-02
Caud. Nucl.	0.00E+00	1.16E-04	8.71E-04	1.87E-03	1.40E-03	8.23E-04	7.67E-04	7.39E-04	6.62E-04	6.27E-04	5.86E-04	4.51E-04
Cerebellum	8.01E-03	2.20E-02	3.15E-02	2.98E-02	1.68E-02	1.02E-02	9.92E-03	1.01E-02	9.32E-03	8.45E-03	7.85E-03	6.31E-03
Cereb. Cort.	8.98E-01	7.02E-01	5.08E-01	2.73E-01	1.18E-01	7.02E-02	7.23E-02	7.50E-02	6.84E-02	6.12E-02	5.40E-02	3.83E-02
Cranium	2.84E-02	1.24E-01	2.17E-01	2.41E-01	1.30E-01	4.44E-02	2.96E-02	2.78E-02	2.59E-02	2.37E-02	2.22E-02	1.75E-02
Eyes	0.00E+00	1.00E-06‡	3.56E-05	2.84E-04	4.60E-04	4.06E-04	4.24E-04	4.77E-04	3.90E-04	4.00E-04	3.52E-04	2.98E-04
Lent. Nucl.	4.99E-05	8.27E-04	2.44E-03	3.75E-03	2.54E-03	1.57E-03	1.43E-03	1.37E-03	1.29E-03	1.18E-03	1.09E-03	9.06E-04
Mandible	0.00E+00	6.99E-05	8.35E-04	5.27E-03	9.42E-03	5.88E-03	3.91E-03	3.50E-03	3.23E-03	3.13E-03	2.95E-03	2.40E-03
Other Tissues	0.00E+00	6.50E-04	6.29E-03	2.39E-02	2.89E-02	2.34E-02	2.37E-02	2.45E-02	2.35E-02	2.22E-02	2.05E-02	1.69E-02
Skin	0.00E+00	4.79E-04	3.24E-03	8.24E-03	7.22E-03	5.45E-03	5.94E-03	6.47E-03	6.22E-03	5.61E-03	5.12E-03	4.08E-03
Spinal Col.	0.00E+00	2.99E-06†	1.14E-05*	6.21E-05	8.93E-05	9.18E-05	9.05E-05	9.48E-05	7.34E-05	6.63E-05	6.98E-05	6.24E-05
Spinal Skel.	0.00E+00	3.39E-05	6.06E-04	4.01E-03	6.41E-03	3.66E-03	2.29E-03	1.95E-03	1.84E-03	1.69E-03	1.60E-03	1.30E-03
Thalami	0.00E+00	2.88E-04	1.39E-03	2.91E-03	2.15E-03	1.29E-03	1.15E-03	1.14E-03	1.05E-03	9.60E-04	9.31E-04	7.29E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.03E-05	4.25E-05	6.18E-05	6.19E-05	6.79E-05	7.12E-05	7.65E-05	7.31E-05	6.41E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	6.66E-05	7.90E-04	1.61E-03	2.01E-03	3.14E-03	4.06E-03	4.61E-03	4.74E-03	5.27E-03
White Matter	4.45E-02	1.22E-01	1.72E-01	1.62E-01	9.03E-02	5.31E-02	5.15E-02	5.16E-02	4.82E-02	4.42E-02	4.09E-02	3.21E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.96E-01	9.83E-01	9.57E-01	9.29E-01	8.99E-01	7.95E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.94E-07‡	8.36E-07*	1.58E-06	4.63E-06	4.52E-06	7.94E-06	3.09E-05
Cerebellum	2.97E-06*	7.81E-06*	1.05E-05	2.53E-05	5.61E-05	2.08E-04	6.73E-04	2.62E-03	6.64E-03	1.11E-02	1.51E-02	2.89E-02
Cereb. Cort.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.92E-01	9.67E-01	9.14E-01	8.57E-01	7.98E-01	6.01E-01
Cranium	0.00E+00	0.00E+00	5.93E-07‡	5.57E-06*	8.29E-06*	3.40E-05	6.44E-05	8.89E-04	1.65E-02	4.02E-02	6.59E-02	1.22E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.13E-07*	2.10E-06*	2.75E-06	3.57E-06	3.32E-05
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.05E-07‡	9.58E-07*	3.56E-06	1.11E-05	5.32E-05	1.51E-04	1.12E-03
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.14E-06*	3.04E-06*	1.33E-05	2.19E-05	2.89E-05	5.93E-05	6.28E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.65E-07‡	3.23E-06*	1.19E-05	4.66E-05	9.85E-05	1.63E-04	3.54E-04	9.65E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.40E-08‡	9.25E-07‡	3.22E-06	1.14E-05	2.71E-05	3.89E-05	1.49E-04	9.95E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.61E-08†	2.42E-07†	5.72E-07	9.96E-07*	3.18E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.28E-07‡	2.12E-06*	5.69E-06	1.17E-05	1.67E-05	2.17E-05	4.73E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-07‡	1.34E-06*	3.78E-06	6.15E-06	8.08E-06	1.05E-05	1.58E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-08‡	3.80E-08‡	6.41E-08	3.25E-07	4.83E-07*	1.08E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-06†	3.96E-06*	9.68E-06	1.47E-05	2.14E-05	6.12E-05
White Matter	1.73E-05	3.27E-05	5.55E-05	1.42E-04	3.75E-04	1.18E-03	3.52E-03	1.41E-02	3.63E-02	6.07E-02	8.52E-02	1.62E-01

Table A.61: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Cranial CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.11E-01	3.86E-01	3.80E-01	2.92E-01	1.59E-01	9.84E-02	9.86E-02	1.01E-01	9.37E-02	8.58E-02	7.89E-02	6.08E-02
Caud. Nucl.	0.00E+00	3.91E-05	4.35E-04	1.12E-03	9.03E-04	5.83E-04	5.68E-04	5.54E-04	5.23E-04	4.65E-04	4.32E-04	3.43E-04
Cerebellum	4.17E-02	5.11E-02	4.82E-02	3.38E-02	1.71E-02	1.05E-02	1.06E-02	1.09E-02	1.00E-02	9.28E-03	8.45E-03	6.57E-03
Cereb. Cort.	2.69E-01	3.10E-01	2.65E-01	1.64E-01	7.83E-02	4.83E-02	4.96E-02	5.17E-02	4.80E-02	4.35E-02	3.97E-02	2.94E-02
Cranium	3.31E-01	4.49E-01	4.75E-01	3.74E-01	1.70E-01	5.56E-02	4.01E-02	3.91E-02	3.66E-02	3.27E-02	2.95E-02	2.06E-02
Eyes	0.00E+00	2.04E-06‡	4.20E-05	2.85E-04	4.26E-04	4.11E-04	4.43E-04	4.82E-04	4.46E-04	4.01E-04	3.89E-04	3.19E-04
Lent. Nucl.	3.00E-06†	3.43E-04	1.35E-03	2.47E-03	1.87E-03	1.19E-03	1.10E-03	1.12E-03	9.94E-04	9.14E-04	8.29E-04	6.86E-04
Mandible	0.00E+00	1.40E-04	1.20E-03	6.04E-03	9.97E-03	6.05E-03	4.10E-03	3.71E-03	3.51E-03	3.31E-03	3.20E-03	2.64E-03
Other Tissues	0.00E+00	1.60E-03	1.09E-02	3.06E-02	3.31E-02	2.67E-02	2.72E-02	2.87E-02	2.75E-02	2.57E-02	2.39E-02	1.95E-02
Skin	1.00E-06‡	9.48E-04	5.09E-03	1.00E-02	8.11E-03	6.17E-03	6.88E-03	7.62E-03	7.14E-03	6.57E-03	6.02E-03	4.65E-03
Spinal Col.	0.00E+00	2.52E-09‡	2.62E-05	8.22E-05	1.22E-04	1.00E-04	1.11E-04	1.18E-04	1.11E-04	9.47E-05	1.02E-04	6.73E-05
Spinal Skel.	0.00E+00	1.04E-04	1.00E-03	5.13E-03	7.75E-03	4.16E-03	2.67E-03	2.44E-03	2.21E-03	2.06E-03	2.00E-03	1.58E-03
Thalami	0.00E+00	9.26E-05	6.96E-04	1.76E-03	1.49E-03	9.39E-04	8.66E-04	8.28E-04	7.96E-04	7.23E-04	6.33E-04	5.72E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.69E-05	5.05E-05	5.75E-05	5.85E-05	7.14E-05	8.29E-05	7.25E-05	8.17E-05	6.20E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	8.42E-05	8.52E-04	1.66E-03	2.16E-03	3.21E-03	4.08E-03	4.54E-03	4.85E-03	5.24E-03
White Matter	5.47E-04	2.42E-02	6.47E-02	8.70E-02	5.73E-02	3.58E-02	3.48E-02	3.47E-02	3.25E-02	3.00E-02	2.80E-02	2.25E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	3.10E-04	6.37E-04	1.01E-03	2.11E-03	5.32E-03	1.76E-02	5.52E-02	2.11E-01	3.43E-01	3.87E-01	4.06E-01	4.22E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.35E-07‡	3.82E-07‡	1.22E-06*	3.85E-06	4.37E-06	5.40E-06	9.95E-06
Cerebellum	4.69E-05	8.73E-05	1.29E-04	2.53E-04	7.00E-04	2.41E-03	7.23E-03	2.82E-02	4.62E-02	5.22E-02	5.46E-02	5.54E-02
Cereb. Cort.	2.64E-04	5.50E-04	8.77E-04	1.86E-03	4.61E-03	1.52E-02	4.80E-02	1.83E-01	2.97E-01	3.34E-01	3.51E-01	3.33E-01
Cranium	3.01E-04	6.32E-04	1.04E-03	2.17E-03	5.23E-03	1.77E-02	5.51E-02	2.12E-01	3.49E-01	3.99E-01	4.13E-01	3.13E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-08‡	0.00E+00	5.46E-07*	2.31E-06	2.93E-06	3.32E-06	1.17E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-08†	8.89E-07*	2.72E-06	5.29E-06	7.80E-06	1.27E-05	2.44E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.72E-07‡	5.34E-06*	1.05E-05	2.36E-05	4.72E-05	2.88E-04	1.79E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-06‡	3.71E-06*	1.65E-05	5.62E-05	1.25E-04	2.83E-04	3.68E-03	3.90E-02
Skin	0.00E+00	0.00E+00	0.00E+00	2.64E-08‡	0.00E+00	2.48E-07†	3.71E-06	1.42E-05	3.91E-05	5.26E-05	4.38E-03	2.98E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.86E-07*	5.19E-07*	4.61E-07	6.64E-06	1.35E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	7.30E-07‡	0.00E+00	1.02E-06‡	3.38E-06*	8.02E-06	1.45E-05	2.43E-05	1.38E-04	2.18E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.37E-07†	2.81E-06	4.35E-06	7.03E-06	7.45E-06	1.86E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.66E-08†	3.77E-07*	4.23E-07*	5.50E-07	1.30E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.63E-07‡	1.24E-07‡	3.85E-06*	9.57E-06	1.67E-05	2.47E-05	6.83E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	1.85E-08‡	1.48E-06*	1.21E-05	3.11E-05	8.60E-05	1.88E-04	2.76E-04	5.47E-04	3.32E-02

Table A.62: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Cranium.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.42E-02	6.55E-02	1.31E-01	1.80E-01	1.25E-01	8.24E-02	8.27E-02	8.53E-02	8.03E-02	7.37E-02	6.91E-02	5.46E-02
Caud. Nucl.	0.00E+00	1.30E-05	2.09E-04	8.37E-04	7.87E-04	5.21E-04	5.18E-04	4.81E-04	4.62E-04	4.18E-04	3.73E-04	3.40E-04
Cerebellum	1.88E-03	8.29E-03	1.61E-02	2.03E-02	1.35E-02	8.68E-03	8.82E-03	9.05E-03	8.60E-03	7.85E-03	7.27E-03	5.84E-03
Cereb. Cort.	1.23E-02	5.11E-02	8.57E-02	9.49E-02	5.92E-02	3.91E-02	4.00E-02	4.19E-02	3.95E-02	3.63E-02	3.41E-02	2.64E-02
Cranium	9.45E-01	8.28E-01	6.69E-01	4.21E-01	1.82E-01	6.04E-02	4.50E-02	4.43E-02	4.03E-02	3.53E-02	3.10E-02	2.08E-02
Eyes	0.00E+00	4.74E-06†	7.48E-05	3.06E-04	4.43E-04	3.94E-04	4.53E-04	4.65E-04	4.55E-04	4.19E-04	3.79E-04	3.20E-04
Lent. Nucl.	0.00E+00	7.81E-05	6.48E-04	1.75E-03	1.56E-03	1.02E-03	9.88E-04	9.32E-04	9.15E-04	8.32E-04	7.76E-04	6.47E-04
Mandible	2.81E-04	1.26E-03	3.11E-03	7.66E-03	1.05E-02	6.10E-03	4.09E-03	3.82E-03	3.67E-03	3.47E-03	3.26E-03	2.74E-03
Other Tissues	8.46E-03	2.12E-02	3.28E-02	4.01E-02	3.53E-02	2.77E-02	2.84E-02	3.02E-02	2.90E-02	2.69E-02	2.50E-02	2.01E-02
Skin	1.18E-02	1.79E-02	1.86E-02	1.50E-02	9.22E-03	7.10E-03	8.05E-03	8.77E-03	8.28E-03	7.51E-03	6.71E-03	4.89E-03
Spinal Col.	2.50E-05*	7.70E-05	8.62E-05	1.03E-04	1.09E-04	1.19E-04	1.11E-04	1.12E-04	1.06E-04	1.04E-04	9.44E-05	8.33E-05
Spinal Skel.	4.35E-04	1.48E-03	3.29E-03	6.89E-03	8.26E-03	4.32E-03	2.80E-03	2.55E-03	2.37E-03	2.25E-03	1.99E-03	1.64E-03
Thalami	0.00E+00	2.69E-05	3.42E-04	1.21E-03	1.27E-03	8.70E-04	7.95E-04	8.00E-04	7.16E-04	6.68E-04	6.47E-04	4.76E-04
Thyroid	0.00E+00	0.00E+00	9.90E-07‡	1.17E-05	5.13E-05	5.65E-05	6.01E-05	7.15E-05	7.90E-05	7.91E-05	7.19E-05	7.45E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	8.41E-05	8.62E-04	1.64E-03	2.09E-03	3.09E-03	4.15E-03	4.55E-03	4.72E-03	5.00E-03
White Matter	5.80E-05	6.06E-03	2.82E-02	5.96E-02	4.75E-02	3.12E-02	3.05E-02	3.12E-02	2.91E-02	2.67E-02	2.52E-02	2.02E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	1.98E-06‡	6.42E-06*	2.64E-05	8.07E-05	1.50E-03	2.87E-02	7.08E-02	1.15E-01	2.30E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-07‡	2.11E-07†	7.79E-07	2.45E-06	4.43E-06	6.14E-06	8.17E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	7.26E-07‡	4.68E-07‡	2.65E-06*	8.68E-06	1.38E-04	3.61E-03	9.17E-03	1.47E-02	3.02E-02
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.55E-07‡	4.47E-06†	1.58E-05	4.12E-05	1.26E-03	2.49E-02	6.14E-02	1.00E-01	1.87E-01
Cranium	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.95E-01	9.85E-01	9.41E-01	8.48E-01	7.44E-01	6.41E-01	4.00E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.84E-08‡	1.80E-07†	6.39E-07*	1.74E-06	3.59E-06	5.26E-06	2.68E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-07‡	1.26E-06*	2.60E-06	5.31E-06	8.42E-06	1.10E-05	9.72E-05
Mandible	0.00E+00	8.11E-07‡	1.31E-06‡	3.69E-06*	6.69E-06†	1.94E-05	7.37E-05	2.53E-04	6.84E-04	1.23E-03	1.73E-03	3.58E-03
Other Tissues	1.31E-05*	1.99E-05	4.05E-05	9.89E-05	2.50E-04	7.82E-04	2.55E-03	9.69E-03	2.35E-02	3.80E-02	5.03E-02	7.20E-02
Skin	2.54E-05	5.50E-05	9.27E-05	1.38E-04	4.14E-04	1.25E-03	4.10E-03	1.68E-02	4.05E-02	5.34E-02	6.00E-02	5.12E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-06‡	4.70E-06	2.53E-05	6.74E-05	1.15E-04	1.67E-04	2.55E-04
Spinal Skel.	1.03E-06‡	2.16E-06†	4.51E-06*	3.98E-06†	1.19E-05	3.47E-05	1.10E-04	4.39E-04	1.15E-03	1.87E-03	2.63E-03	4.41E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-07‡	4.65E-07‡	5.20E-07‡	1.72E-06*	4.05E-06	6.75E-06	7.68E-06	1.34E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-08‡	4.64E-07*	3.81E-07*	9.29E-07†	1.33E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.95E-07‡	3.86E-06	1.19E-05	1.61E-05	2.40E-05	6.09E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	6.00E-07‡	1.07E-06†	6.00E-06	2.84E-05	8.64E-05	1.85E-04	2.70E-04	3.62E-04	1.20E-02

Table A.63: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Lateral Ventricles.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	9.79E-01	7.59E-01	3.84E-01	2.20E-01	2.13E-01	2.13E-01	1.95E-01	1.76E-01	1.60E-01	1.22E-01
Caud. Nucl.	2.18E-03	1.46E-02	2.12E-02	1.58E-02	6.91E-03	3.78E-03	3.70E-03	3.71E-03	3.48E-03	3.19E-03	2.94E-03	2.26E-03
Cerebellum	0.00E+00	7.39E-04	6.59E-03	1.86E-02	1.53E-02	9.26E-03	8.46E-03	8.31E-03	7.68E-03	7.05E-03	6.52E-03	5.22E-03
Cereb. Cort.	2.77E-03	3.59E-02	9.48E-02	1.45E-01	9.52E-02	5.63E-02	5.30E-02	5.18E-02	4.80E-02	4.40E-02	4.06E-02	3.29E-02
Cranium	0.00E+00	2.32E-04	1.48E-02	9.41E-02	9.35E-02	3.71E-02	2.15E-02	1.84E-02	1.67E-02	1.54E-02	1.44E-02	1.19E-02
Eyes	0.00E+00	0.00E+00	1.03E-06‡	1.43E-04	3.61E-04	3.78E-04	4.10E-04	4.04E-04	3.71E-04	3.67E-04	3.26E-04	2.74E-04
Lent. Nucl.	6.57E-04	7.19E-03	1.60E-02	1.67E-02	8.49E-03	4.72E-03	4.52E-03	4.46E-03	4.12E-03	3.76E-03	3.39E-03	2.70E-03
Mandible	0.00E+00	0.00E+00	1.13E-04	3.54E-03	9.77E-03	6.57E-03	4.18E-03	3.52E-03	3.29E-03	3.10E-03	2.92E-03	2.48E-03
Other Tissues	0.00E+00	4.42E-06†	8.53E-04	1.52E-02	2.83E-02	2.42E-02	2.32E-02	2.33E-02	2.24E-02	2.08E-02	1.96E-02	1.61E-02
Skin	0.00E+00	0.00E+00	2.75E-04	3.61E-03	5.29E-03	4.30E-03	4.46E-03	4.87E-03	4.53E-03	4.20E-03	3.84E-03	3.20E-03
Spinal Col.	0.00E+00	0.00E+00	1.98E-06‡	4.72E-05	9.18E-05	9.12E-05	8.72E-05	9.34E-05	8.33E-05	6.92E-05	6.98E-05	6.16E-05
Spinal Skel.	0.00E+00	0.00E+00	6.84E-05	2.12E-03	6.01E-03	3.81E-03	2.27E-03	1.87E-03	1.62E-03	1.60E-03	1.44E-03	1.17E-03
Thalami	1.73E-03	1.25E-02	2.35E-02	2.08E-02	9.59E-03	5.23E-03	5.17E-03	5.13E-03	4.64E-03	4.21E-03	4.04E-03	3.14E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.06E-05*	4.87E-05	6.10E-05	6.63E-05	7.62E-05	8.33E-05	7.34E-05	7.70E-05	7.06E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	6.86E-05	8.88E-04	1.87E-03	2.44E-03	3.59E-03	4.87E-03	5.52E-03	5.94E-03	6.54E-03
White Matter	1.43E-01	3.30E-01	4.39E-01	3.85E-01	1.96E-01	1.10E-01	1.06E-01	1.05E-01	9.72E-02	8.84E-02	8.14E-02	6.33E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.13E-07‡	2.27E-06*	4.02E-06	1.28E-05	2.30E-04	2.24E-03	6.02E-03	2.38E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-06‡	2.07E-06†	8.21E-06	2.06E-05	4.41E-05	6.24E-05	8.19E-05	1.53E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	3.63E-06*	5.99E-06*	1.80E-05	4.40E-05	1.41E-04	4.04E-04	2.65E-03	7.67E-03	4.85E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-06†	1.18E-05	3.36E-05	8.38E-05	1.47E-04	2.10E-04	2.50E-04	4.02E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.87E-07‡	1.63E-07‡	6.00E-07*	1.39E-06	2.52E-06	3.35E-06	6.72E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	5.06E-07‡	1.05E-06‡	2.11E-06*	5.70E-06	1.54E-05	8.04E-05	7.17E-04	1.94E-03	9.00E-03
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.08E-07‡	3.41E-06*	1.19E-05	2.11E-05	3.33E-05	3.93E-05	6.76E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.61E-08‡	3.07E-06*	1.07E-05	4.32E-05	9.54E-05	1.53E-04	2.06E-04	3.93E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-06†	1.43E-06*	8.96E-06	1.83E-05	2.67E-05	4.11E-05	7.82E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.85E-08†	1.57E-07‡	1.57E-07*	3.35E-07*	6.44E-07*	2.23E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.52E-07‡	3.94E-09‡	2.67E-06	4.92E-06	1.16E-05	1.61E-05	2.36E-05	3.45E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-06‡	2.65E-06*	5.85E-06	5.81E-05	7.21E-04	2.24E-03	4.52E-03	1.68E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-07†	4.36E-07†	3.88E-07*	5.08E-07*	1.50E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.09E-07‡	4.46E-07‡	4.17E-06	1.03E-05	2.13E-05	2.85E-05	6.78E-05
White Matter	6.16E-05	1.26E-04	2.28E-04	4.85E-04	1.14E-03	3.90E-03	1.20E-02	4.78E-02	1.22E-01	1.97E-01	2.63E-01	4.23E-01

Table A.64: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Lentiform Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.92E-01	9.33E-01	6.76E-01	3.38E-01	1.97E-01	1.91E-01	1.92E-01	1.75E-01	1.58E-01	1.43E-01	1.09E-01
Caud. Nucl.	2.02E-02	4.05E-02	3.98E-02	2.33E-02	9.28E-03	5.11E-03	5.22E-03	5.36E-03	4.94E-03	4.52E-03	4.08E-03	2.89E-03
Cerebellum	0.00E+00	5.45E-05	1.57E-03	8.79E-03	9.37E-03	6.32E-03	5.59E-03	5.38E-03	5.05E-03	4.69E-03	4.26E-03	3.51E-03
Cereb. Cort.	1.67E-03	2.64E-02	7.38E-02	1.13E-01	7.77E-02	4.75E-02	4.43E-02	4.37E-02	4.01E-02	3.66E-02	3.39E-02	2.76E-02
Cranium	1.70E-05	6.92E-03	4.79E-02	1.30E-01	1.05E-01	4.08E-02	2.40E-02	2.06E-02	1.85E-02	1.73E-02	1.60E-02	1.31E-02
Eyes	0.00E+00	0.00E+00	8.06E-06†	3.14E-04	6.65E-04	6.51E-04	6.35E-04	6.89E-04	6.09E-04	5.24E-04	5.17E-04	4.13E-04
Lent. Nucl.	8.46E-01	5.91E-01	3.64E-01	1.46E-01	4.77E-02	2.77E-02	2.97E-02	3.14E-02	2.76E-02	2.36E-02	1.97E-02	1.09E-02
Mandible	0.00E+00	3.00E-05	1.43E-03	1.33E-02	2.22E-02	1.25E-02	7.87E-03	6.71E-03	6.26E-03	5.70E-03	5.36E-03	4.50E-03
Other Tissues	0.00E+00	2.68E-04	6.60E-03	3.89E-02	5.10E-02	3.98E-02	3.80E-02	3.78E-02	3.55E-02	3.27E-02	3.06E-02	2.50E-02
Skin	0.00E+00	0.00E+00	1.94E-04	2.85E-03	4.72E-03	4.19E-03	4.43E-03	4.75E-03	4.54E-03	4.19E-03	3.88E-03	3.17E-03
Spinal Col.	0.00E+00	0.00E+00	1.07E-06‡	4.30E-05	1.23E-04	8.91E-05	9.89E-05	8.36E-05	7.68E-05	6.57E-05	5.81E-05	5.45E-05
Spinal Skel.	0.00E+00	0.00E+00	1.15E-04	3.20E-03	7.76E-03	4.72E-03	2.72E-03	2.11E-03	1.78E-03	1.68E-03	1.52E-03	1.22E-03
Thalami	3.07E-02	6.45E-02	6.67E-02	4.03E-02	1.58E-02	8.72E-03	8.92E-03	9.21E-03	8.38E-03	7.62E-03	6.92E-03	5.10E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	2.79E-05	9.74E-05	1.09E-04	1.09E-04	1.33E-04	1.23E-04	1.27E-04	1.10E-04	9.50E-05
Trunk	0.00E+00	0.00E+00	9.91E-07‡	1.64E-04	1.60E-03	2.96E-03	3.60E-03	4.96E-03	6.40E-03	6.97E-03	7.47E-03	7.72E-03
White Matter	1.01E-01	2.61E-01	3.68E-01	3.26E-01	1.69E-01	9.64E-02	9.22E-02	9.17E-02	8.40E-02	7.62E-02	7.08E-02	5.54E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.84E-01
Caud. Nucl.	6.56E-06*	2.08E-05	3.15E-05	7.06E-05	1.60E-04	5.77E-04	1.73E-03	6.80E-03	1.72E-02	2.77E-02	3.71E-02	5.42E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-06*	4.80E-06	1.17E-05	2.67E-05	3.67E-05	5.09E-05	9.45E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	1.55E-06‡	5.88E-06*	1.67E-05	3.42E-05	1.11E-04	2.85E-04	1.45E-03	4.48E-03	3.32E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	1.53E-06‡	3.66E-06*	2.04E-05	3.94E-05	9.91E-05	1.78E-04	2.35E-04	2.83E-04	2.06E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.22E-07‡	3.70E-07‡	1.30E-06*	2.83E-06	3.83E-06	5.04E-06	1.06E-05
Lent. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.96E-01	9.87E-01	9.48E-01	8.68E-01	7.85E-01	7.06E-01	4.62E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.11E-07‡	3.36E-06*	4.98E-06	1.96E-05	4.19E-05	6.49E-05	7.69E-05	1.30E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.17E-07‡	6.45E-06	2.21E-05	7.68E-05	1.65E-04	2.58E-04	3.39E-04	6.75E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.56E-07‡	2.82E-06*	8.40E-06	1.79E-05	3.02E-05	3.99E-05	7.31E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.19E-08‡	1.78E-07‡	3.75E-07†	4.70E-07*	3.85E-07	1.67E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.88E-09‡	3.85E-06	9.07E-06	1.65E-05	1.99E-05	2.38E-05	4.01E-05
Thalami	2.06E-05	2.18E-05	5.79E-05	1.05E-04	2.79E-04	8.92E-04	2.71E-03	1.07E-02	2.63E-02	4.22E-02	5.63E-02	8.68E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-08‡	1.86E-07‡	4.64E-07*	9.35E-07	7.32E-07*	1.88E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.39E-07‡	4.77E-06	1.43E-05	3.02E-05	3.99E-05	9.14E-05
White Matter	3.57E-05	1.01E-04	1.56E-04	3.56E-04	8.28E-04	2.72E-03	8.47E-03	3.34E-02	8.53E-02	1.38E-01	1.87E-01	3.37E-01

Table A.65: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Spinal CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	2.05E-04	2.61E-03	1.40E-02	2.60E-02	2.43E-02	2.40E-02	2.46E-02	2.31E-02	2.17E-02	2.05E-02	1.70E-02
Caud. Nucl.	0.00E+00	0.00E+00	1.00E-06‡	4.86E-05	1.56E-04	1.68E-04	1.57E-04	1.61E-04	1.49E-04	1.25E-04	1.18E-04	1.09E-04
Cerebellum	0.00E+00	2.70E-05	4.16E-04	2.70E-03	4.51E-03	4.01E-03	3.90E-03	3.96E-03	3.71E-03	3.57E-03	3.43E-03	2.71E-03
Cereb. Cort.	0.00E+00	1.57E-04	1.57E-03	6.28E-03	1.05E-02	9.66E-03	9.77E-03	1.01E-02	9.52E-03	8.93E-03	8.44E-03	7.06E-03
Cranium	4.32E-03	1.14E-02	1.69E-02	2.40E-02	2.70E-02	1.44E-02	9.25E-03	8.33E-03	7.58E-03	7.29E-03	6.76E-03	5.41E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	9.81E-07‡	3.62E-05	7.63E-05	1.05E-04	1.12E-04	1.12E-04	1.00E-04	8.61E-05	8.11E-05
Lent. Nucl.	0.00E+00	0.00E+00	5.84E-06†	1.79E-04	4.47E-04	4.47E-04	4.33E-04	4.15E-04	3.99E-04	3.49E-04	3.26E-04	3.03E-04
Mandible	0.00E+00	0.00E+00	3.77E-05	3.61E-03	1.28E-02	8.66E-03	5.61E-03	4.80E-03	4.47E-03	4.10E-03	3.87E-03	3.33E-03
Other Tissues	0.00E+00	1.17E-04	9.27E-03	8.88E-02	1.19E-01	9.16E-02	9.15E-02	9.33E-02	8.73E-02	8.09E-02	7.50E-02	6.14E-02
Skin	0.00E+00	4.20E-08‡	1.73E-04	2.59E-03	4.37E-03	3.92E-03	4.25E-03	4.54E-03	4.49E-03	4.06E-03	3.80E-03	3.06E-03
Spinal Col.	9.32E-02	1.16E-01	8.20E-02	3.44E-02	1.18E-02	6.96E-03	7.44E-03	7.89E-03	7.15E-03	6.59E-03	5.81E-03	3.25E-03
Spinal Skel.	1.85E-01	4.38E-01	6.22E-01	6.08E-01	2.96E-01	9.71E-02	6.82E-02	6.53E-02	6.01E-02	5.50E-02	5.00E-02	3.75E-02
Thalami	0.00E+00	0.00E+00	3.28E-05	2.50E-04	5.14E-04	4.64E-04	4.44E-04	4.64E-04	4.28E-04	3.62E-04	3.73E-04	2.99E-04
Thyroid	0.00E+00	4.27E-08‡	4.30E-05	7.92E-04	1.09E-03	8.28E-04	7.92E-04	7.44E-04	7.47E-04	6.94E-04	6.29E-04	4.94E-04
Trunk	4.27E-03	1.14E-02	1.94E-02	4.02E-02	6.23E-02	5.94E-02	5.92E-02	6.28E-02	6.36E-02	6.23E-02	5.97E-02	5.29E-02
White Matter	0.00E+00	2.09E-05	5.83E-04	4.46E-03	9.47E-03	9.19E-03	8.94E-03	9.14E-03	8.61E-03	8.06E-03	7.51E-03	6.32E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.42E-07‡	2.81E-06*	1.01E-05	4.61E-05	9.53E-05	1.65E-04	2.34E-04	3.56E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-08‡	2.85E-07*	5.51E-07	1.04E-06	2.17E-06	2.88E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-07‡	8.50E-07*	8.37E-06	1.43E-05	2.70E-05	3.79E-05	3.84E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-09‡	1.43E-06*	5.64E-06	1.95E-05	4.03E-05	6.76E-05	1.02E-04	2.99E-03
Cranium	2.66E-06†	5.00E-06*	8.72E-06	1.32E-05	3.51E-05	1.17E-04	3.85E-04	1.55E-03	3.94E-03	6.44E-03	8.83E-03	1.37E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.73E-08†	2.96E-07*	4.97E-07*	5.12E-07*	1.02E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.57E-09‡	5.45E-07*	1.58E-06	3.03E-06	3.12E-06	7.21E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.97E-07‡	7.27E-06	1.61E-05	2.84E-05	4.15E-05	5.44E-05	9.78E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.99E-06†	1.23E-05	3.95E-05	1.84E-04	4.21E-04	6.67E-04	9.30E-04	7.66E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.99E-10‡	1.87E-06	8.41E-06	1.97E-05	2.75E-05	3.95E-05	8.28E-05
Spinal Col.	4.19E-05	8.68E-05	1.65E-04	3.17E-04	8.01E-04	2.66E-03	8.63E-03	3.45E-02	8.81E-02	1.39E-01	1.61E-01	1.16E-01
Spinal Skel.	7.54E-05	1.84E-04	2.91E-04	5.85E-04	1.44E-03	4.94E-03	1.53E-02	6.06E-02	1.57E-01	2.56E-01	3.31E-01	5.16E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.01E-07‡	8.24E-07*	1.66E-06	2.59E-06	4.47E-06	6.84E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E-07‡	3.83E-07†	2.30E-06*	4.04E-06	6.00E-06	7.05E-06	1.38E-05
Trunk	1.93E-06†	6.18E-06*	6.98E-06*	1.29E-05	3.66E-05	1.04E-04	3.98E-04	1.50E-03	3.96E-03	6.63E-03	9.13E-03	1.91E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.40E-07‡	1.28E-06†	3.41E-06*	1.62E-05	3.53E-05	6.12E-05	8.14E-05	1.69E-04

Table A.66: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Spinal Skeleton.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	7.29E-05	1.20E-03	1.08E-02	2.42E-02	2.37E-02	2.35E-02	2.39E-02	2.28E-02	2.16E-02	2.03E-02	1.70E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	3.76E-05	1.39E-04	1.60E-04	1.65E-04	1.56E-04	1.49E-04	1.48E-04	1.37E-04	1.12E-04
Cerebellum	0.00E+00	1.29E-05*	2.40E-04	2.13E-03	4.19E-03	3.86E-03	3.86E-03	3.95E-03	3.75E-03	3.54E-03	3.33E-03	2.79E-03
Cereb. Cort.	0.00E+00	4.89E-05	6.92E-04	4.71E-03	9.57E-03	9.49E-03	9.43E-03	9.77E-03	9.37E-03	8.85E-03	8.32E-03	6.93E-03
Cranium	1.18E-03	3.96E-03	9.22E-03	2.01E-02	2.59E-02	1.38E-02	9.07E-03	8.06E-03	7.61E-03	7.09E-03	6.73E-03	5.53E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	1.27E-07‡	3.66E-05	7.50E-05	8.87E-05	1.07E-04	1.05E-04	1.07E-04	9.63E-05	8.19E-05
Lent. Nucl.	0.00E+00	0.00E+00	1.95E-06‡	1.39E-04	4.76E-04	4.31E-04	4.19E-04	4.18E-04	3.77E-04	3.50E-04	3.31E-04	2.90E-04
Mandible	0.00E+00	3.00E-06†	2.24E-04	4.79E-03	1.32E-02	8.77E-03	5.58E-03	4.79E-03	4.41E-03	4.19E-03	3.90E-03	3.36E-03
Other Tissues	1.38E-02	4.20E-02	8.13E-02	1.40E-01	1.31E-01	9.82E-02	9.90E-02	1.02E-01	9.51E-02	8.79E-02	8.18E-02	6.63E-02
Skin	9.99E-07‡	2.11E-04	1.23E-03	3.80E-03	4.60E-03	3.99E-03	4.44E-03	4.87E-03	4.52E-03	4.31E-03	3.94E-03	3.15E-03
Spinal Col.	3.78E-04	3.53E-03	6.20E-03	6.70E-03	3.82E-03	2.55E-03	2.67E-03	2.74E-03	2.61E-03	2.32E-03	2.15E-03	1.67E-03
Spinal Skel.	9.76E-01	9.28E-01	8.51E-01	6.36E-01	3.00E-01	1.01E-01	7.35E-02	7.12E-02	6.46E-02	5.73E-02	5.06E-02	3.51E-02
Thalami	0.00E+00	0.00E+00	8.11E-06*	2.02E-04	5.21E-04	4.64E-04	4.50E-04	4.40E-04	3.96E-04	3.73E-04	3.67E-04	2.84E-04
Thyroid	0.00E+00	1.89E-05	2.45E-04	9.44E-04	1.16E-03	7.95E-04	7.80E-04	8.00E-04	7.47E-04	7.12E-04	5.95E-04	5.22E-04
Trunk	1.06E-03	4.04E-03	1.06E-02	3.28E-02	5.66E-02	5.55E-02	5.57E-02	5.98E-02	6.03E-02	5.89E-02	5.74E-02	5.04E-02
White Matter	0.00E+00	1.10E-05*	2.58E-04	3.49E-03	8.96E-03	8.95E-03	8.80E-03	8.83E-03	8.42E-03	8.06E-03	7.51E-03	6.37E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.89E-08‡	2.23E-06†	1.52E-05	5.04E-05	1.17E-04	1.88E-04	2.59E-04	3.09E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.95E-08*	5.95E-07*	8.71E-07	1.51E-06	2.64E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-07‡	1.94E-06	8.04E-06	1.88E-05	3.12E-05	4.27E-05	7.25E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.89E-08‡	4.08E-07‡	4.83E-06	2.04E-05	4.68E-05	7.47E-05	1.07E-04	2.17E-03
Cranium	1.12E-06‡	2.93E-06†	8.14E-06	7.32E-06†	3.10E-05	8.78E-05	3.09E-04	1.15E-03	3.07E-03	5.13E-03	7.26E-03	1.22E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-07†	4.59E-07*	9.24E-07*	6.99E-07*	1.32E-06*
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E-07†	5.45E-07*	2.29E-06	2.98E-06	4.58E-06	7.15E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.92E-06†	6.18E-06	1.65E-05	3.83E-05	4.90E-05	6.30E-05	1.07E-04
Other Tissues	2.12E-05*	5.25E-05	6.61E-05	1.38E-04	3.40E-04	1.16E-03	3.71E-03	1.45E-02	3.68E-02	6.12E-02	8.70E-02	1.82E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-06‡	2.54E-06*	8.32E-06	2.20E-05	3.57E-05	4.89E-05	2.30E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.60E-07‡	1.31E-06‡	2.73E-06	8.65E-06	1.79E-05	7.20E-04	3.78E-03	1.97E-02
Spinal Skel.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.73E-01	9.32E-01	8.87E-01	8.40E-01	6.70E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.67E-07‡	9.57E-07†	1.88E-06	3.53E-06	4.86E-06	8.91E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.41E-07‡	8.70E-07*	2.72E-06	5.11E-06	7.00E-06	7.25E-06	1.55E-05
Trunk	7.21E-07‡	2.00E-06‡	2.11E-06†	9.40E-06*	3.03E-05	1.15E-04	2.84E-04	1.20E-03	3.18E-03	5.26E-03	7.61E-03	1.68E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06‡	7.78E-06	1.99E-05	4.46E-05	7.17E-05	9.46E-05	1.77E-04

Table A.67: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Thalami.

	Photon Absorbed Fraction of Energy: φ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.97E-01	9.57E-01	7.15E-01	3.62E-01	2.09E-01	2.02E-01	2.02E-01	1.84E-01	1.67E-01	1.52E-01	1.15E-01
Caud. Nucl.	3.29E-03	1.36E-02	1.85E-02	1.39E-02	6.33E-03	3.46E-03	3.42E-03	3.36E-03	3.11E-03	2.83E-03	2.66E-03	2.05E-03
Cerebellum	0.00E+00	2.23E-04	4.92E-03	1.74E-02	1.54E-02	9.48E-03	8.69E-03	8.41E-03	7.70E-03	6.98E-03	6.58E-03	5.34E-03
Cereb. Cort.	7.09E-05	1.09E-02	5.61E-02	1.09E-01	7.97E-02	4.85E-02	4.46E-02	4.35E-02	3.99E-02	3.68E-02	3.39E-02	2.75E-02
Cranium	0.00E+00	2.52E-03	3.14E-02	1.15E-01	1.02E-01	4.01E-02	2.32E-02	1.95E-02	1.79E-02	1.64E-02	1.54E-02	1.27E-02
Eyes	0.00E+00	0.00E+00	1.03E-06‡	1.22E-04	3.95E-04	4.38E-04	4.44E-04	4.43E-04	4.19E-04	4.08E-04	3.62E-04	2.93E-04
Lent. Nucl.	3.78E-02	7.91E-02	8.22E-02	4.94E-02	1.96E-02	1.08E-02	1.10E-02	1.13E-02	1.03E-02	9.19E-03	8.57E-03	6.21E-03
Mandible	0.00E+00	2.00E-06‡	5.82E-04	1.02E-02	1.95E-02	1.14E-02	7.08E-03	5.94E-03	5.41E-03	4.95E-03	4.71E-03	3.84E-03
Other Tissues	0.00E+00	1.35E-04	5.27E-03	4.16E-02	5.55E-02	4.26E-02	4.00E-02	4.01E-02	3.73E-02	3.44E-02	3.19E-02	2.64E-02
Skin	0.00E+00	0.00E+00	1.20E-04	2.63E-03	4.64E-03	4.08E-03	4.26E-03	4.57E-03	4.35E-03	4.06E-03	3.73E-03	3.07E-03
Spinal Col.	0.00E+00	0.00E+00	7.03E-06*	1.16E-04	1.66E-04	1.51E-04	1.44E-04	1.29E-04	1.12E-04	1.17E-04	1.05E-04	8.62E-05
Spinal Skel.	0.00E+00	1.99E-06‡	3.44E-04	6.16E-03	1.16E-02	6.45E-03	3.81E-03	2.90E-03	2.65E-03	2.30E-03	2.18E-03	1.74E-03
Thalami	8.64E-01	6.13E-01	3.82E-01	1.55E-01	5.05E-02	2.89E-02	3.13E-02	3.29E-02	2.90E-02	2.47E-02	2.11E-02	1.19E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	4.42E-05	1.30E-04	1.14E-04	1.09E-04	1.27E-04	1.21E-04	1.14E-04	1.04E-04	1.02E-04
Trunk	0.00E+00	0.00E+00	9.89E-07‡	1.96E-04	1.84E-03	3.23E-03	3.99E-03	5.63E-03	7.14E-03	7.92E-03	8.31E-03	8.75E-03
White Matter	8.98E-02	2.53E-01	3.71E-01	3.37E-01	1.75E-01	9.94E-02	9.51E-02	9.48E-02	8.65E-02	7.94E-02	7.29E-02	5.74E-02

	Electron Absorbed Fraction of Energy: φ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-07‡	3.08E-06*	1.24E-05	2.84E-04	1.78E-03	4.51E-03	7.96E-03	2.03E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.62E-07‡	2.55E-06*	6.54E-06	2.18E-05	4.31E-05	6.47E-05	7.62E-05	1.50E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.46E-06	1.27E-05	3.55E-05	1.16E-04	2.32E-04	3.29E-04	4.29E-04	5.79E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-06†	1.54E-05	3.58E-05	9.76E-05	1.68E-04	2.32E-04	2.75E-04	4.43E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.83E-08‡	7.11E-07	1.44E-06	3.61E-06	4.37E-06	6.96E-06
Lent. Nucl.	1.05E-05	4.32E-05	5.49E-05	1.20E-04	3.17E-04	1.02E-03	3.41E-03	1.32E-02	3.25E-02	5.23E-02	6.97E-02	1.07E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-06†	7.72E-06	2.01E-05	3.89E-05	5.44E-05	6.84E-05	1.18E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	8.03E-07‡	2.59E-07‡	7.21E-06*	2.27E-05	7.75E-05	1.75E-04	2.70E-04	3.63E-04	6.63E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.75E-07‡	2.43E-06	6.32E-06	1.81E-05	2.73E-05	3.65E-05	7.09E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-07‡	8.23E-07	5.96E-07	1.15E-06	2.01E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-06†	1.84E-06*	1.19E-05	2.00E-05	2.91E-05	3.44E-05	6.28E-05
Thalami	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.89E-01	9.56E-01	8.86E-01	8.09E-01	7.34E-01	4.80E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.41E-08‡	1.61E-07‡	8.06E-07*	1.05E-06*	8.61E-07	1.88E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.17E-07‡	5.78E-06	1.70E-05	2.56E-05	4.25E-05	1.00E-04
White Matter	4.70E-05	7.87E-05	1.14E-04	2.94E-04	7.16E-04	2.30E-03	7.21E-03	2.88E-02	7.52E-02	1.23E-01	1.68E-01	3.32E-01

Table A.68: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Third Ventricle.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.99E-01	9.70E-01	7.41E-01	3.77E-01	2.17E-01	2.09E-01	2.09E-01	1.90E-01	1.73E-01	1.57E-01	1.19E-01
Caud. Nucl.	3.02E-06†	2.78E-03	9.77E-03	1.11E-02	5.53E-03	2.99E-03	2.86E-03	2.86E-03	2.59E-03	2.35E-03	2.22E-03	1.83E-03
Cerebellum	0.00E+00	2.46E-04	5.16E-03	1.87E-02	1.62E-02	9.80E-03	8.92E-03	8.57E-03	7.92E-03	7.14E-03	6.79E-03	5.53E-03
Cereb. Cort.	4.00E-06†	6.16E-03	4.65E-02	1.07E-01	8.06E-02	4.89E-02	4.49E-02	4.38E-02	3.99E-02	3.67E-02	3.41E-02	2.78E-02
Cranium	0.00E+00	1.05E-03	2.14E-02	1.03E-01	9.79E-02	3.93E-02	2.26E-02	1.89E-02	1.72E-02	1.58E-02	1.48E-02	1.21E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	1.45E-04	4.29E-04	4.26E-04	4.61E-04	4.43E-04	4.14E-04	3.79E-04	3.55E-04	2.92E-04
Lent. Nucl.	1.75E-04	1.29E-02	3.25E-02	3.01E-02	1.39E-02	7.55E-03	7.31E-03	7.27E-03	6.78E-03	6.14E-03	5.66E-03	4.55E-03
Mandible	0.00E+00	0.00E+00	3.39E-04	7.64E-03	1.70E-02	1.02E-02	6.38E-03	5.31E-03	4.89E-03	4.60E-03	4.32E-03	3.55E-03
Other Tissues	0.00E+00	4.94E-05	3.63E-03	3.38E-02	4.93E-02	3.87E-02	3.65E-02	3.64E-02	3.40E-02	3.13E-02	2.94E-02	2.38E-02
Skin	0.00E+00	1.00E-06‡	1.27E-04	2.56E-03	4.63E-03	4.00E-03	4.25E-03	4.59E-03	4.39E-03	4.03E-03	3.70E-03	3.07E-03
Spinal Col.	0.00E+00	1.00E-06‡	1.10E-05*	9.60E-05	1.67E-04	1.40E-04	1.41E-04	1.18E-04	1.13E-04	1.07E-04	9.87E-05	8.29E-05
Spinal Skel.	0.00E+00	2.92E-06†	3.09E-04	5.31E-03	1.08E-02	6.13E-03	3.64E-03	2.78E-03	2.49E-03	2.30E-03	2.16E-03	1.69E-03
Thalami	3.18E-02	1.46E-01	1.56E-01	8.52E-02	3.14E-02	1.72E-02	1.77E-02	1.86E-02	1.72E-02	1.58E-02	1.44E-02	1.03E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	3.61E-05	9.88E-05	1.08E-04	9.97E-05	1.36E-04	1.20E-04	9.95E-05	1.17E-04	9.75E-05
Trunk	0.00E+00	0.00E+00	1.00E-06‡	1.85E-04	1.68E-03	3.10E-03	3.76E-03	5.29E-03	6.80E-03	7.50E-03	7.93E-03	8.47E-03
White Matter	3.57E-01	4.99E-01	5.16E-01	3.98E-01	1.97E-01	1.13E-01	1.08E-01	1.08E-01	9.90E-02	9.02E-02	8.18E-02	6.16E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	6.56E-07‡	4.16E-07‡	1.62E-06*	3.94E-06	1.01E-05	1.61E-05	2.63E-05	2.89E-05	1.89E-04
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-07‡	2.66E-06*	7.34E-06	2.33E-05	4.73E-05	6.69E-05	8.23E-05	1.45E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	6.29E-07‡	3.46E-06*	1.22E-05	3.82E-05	1.16E-04	2.25E-04	3.44E-04	4.36E-04	1.14E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	1.32E-08‡	2.14E-06†	1.52E-05	3.63E-05	9.01E-05	1.62E-04	2.15E-04	2.65E-04	4.02E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E-07‡	3.82E-07*	1.66E-06	3.34E-06	3.48E-06	6.82E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E-06†	5.21E-06*	8.18E-06	2.26E-05	4.40E-05	6.37E-05	9.32E-05	1.16E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.63E-07†	6.05E-06	1.50E-05	3.23E-05	4.80E-05	6.09E-05	1.07E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.31E-07‡	5.83E-06*	1.99E-05	7.46E-05	1.63E-04	2.45E-04	3.13E-04	6.11E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-06*	1.98E-06*	8.79E-06	1.60E-05	2.62E-05	3.49E-05	7.46E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.61E-07*	5.59E-07*	1.58E-06*	1.81E-06	2.37E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.97E-06*	5.45E-06*	9.65E-06	1.87E-05	2.95E-05	3.47E-05	5.39E-05
Thalami	0.00E+00	0.00E+00	3.79E-06†	2.26E-06†	8.20E-06	1.65E-05	3.27E-05	7.86E-05	3.81E-03	3.80E-02	9.84E-02	2.42E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.81E-08‡	2.92E-07†	5.80E-07*	7.86E-07*	7.74E-07*	2.19E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.03E-07‡	1.07E-06*	5.77E-06	1.43E-05	3.01E-05	4.51E-05	9.39E-05
White Matter	1.97E-04	4.32E-04	7.63E-04	1.50E-03	3.75E-03	1.24E-02	3.88E-02	1.53E-01	3.73E-01	5.12E-01	5.51E-01	5.21E-01

Table A.69: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the Thyroid.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	2.08E-05*	1.62E-03	6.31E-03	7.29E-03	7.70E-03	8.77E-03	8.92E-03	8.63E-03	8.40E-03	7.32E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	1.40E-05*	6.47E-05	7.13E-05	7.53E-05	7.96E-05	7.68E-05	7.75E-05	7.71E-05	6.05E-05
Cerebellum	0.00E+00	0.00E+00	0.00E+00	8.31E-05	5.09E-04	6.77E-04	7.39E-04	8.74E-04	8.87E-04	8.84E-04	8.75E-04	7.34E-04
Cereb. Cort.	0.00E+00	0.00E+00	1.29E-05	6.75E-04	2.46E-03	2.89E-03	3.08E-03	3.54E-03	3.69E-03	3.54E-03	3.45E-03	3.02E-03
Cranium	0.00E+00	0.00E+00	6.21E-05	2.10E-03	5.63E-03	3.98E-03	2.72E-03	2.47E-03	2.54E-03	2.44E-03	2.32E-03	2.15E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	1.10E-06‡	2.97E-05	5.98E-05	6.99E-05	1.05E-04	1.06E-04	9.70E-05	9.27E-05	7.93E-05
Lent. Nucl.	0.00E+00	0.00E+00	9.45E-07‡	4.55E-05	1.86E-04	1.84E-04	1.92E-04	1.91E-04	1.92E-04	1.67E-04	1.59E-04	1.43E-04
Mandible	0.00E+00	5.97E-05	1.85E-03	1.36E-02	1.83E-02	8.83E-03	5.45E-03	4.71E-03	4.34E-03	3.93E-03	3.73E-03	2.96E-03
Other Tissues	1.70E-01	3.95E-01	4.80E-01	3.71E-01	1.83E-01	1.10E-01	1.10E-01	1.14E-01	1.06E-01	9.81E-02	9.07E-02	7.09E-02
Skin	2.90E-05	3.24E-03	9.09E-03	1.00E-02	5.74E-03	3.91E-03	4.11E-03	4.39E-03	4.16E-03	3.82E-03	3.54E-03	2.88E-03
Spinal Col.	0.00E+00	0.00E+00	3.19E-05	4.07E-04	5.20E-04	4.36E-04	4.06E-04	4.06E-04	3.78E-04	3.59E-04	3.46E-04	2.88E-04
Spinal Skel.	0.00E+00	6.29E-04	9.76E-03	3.96E-02	4.12E-02	1.74E-02	1.08E-02	9.37E-03	8.70E-03	7.90E-03	7.38E-03	6.13E-03
Thalami	0.00E+00	0.00E+00	1.07E-06‡	4.41E-05	1.65E-04	1.64E-04	1.61E-04	1.62E-04	1.60E-04	1.62E-04	1.38E-04	1.32E-04
Thyroid	8.24E-01	5.54E-01	3.37E-01	1.33E-01	4.25E-02	2.45E-02	2.69E-02	2.83E-02	2.49E-02	2.09E-02	1.75E-02	9.60E-03
Trunk	6.08E-03	3.50E-02	8.82E-02	1.66E-01	1.67E-01	1.26E-01	1.20E-01	1.24E-01	1.21E-01	1.16E-01	1.10E-01	9.45E-02
White Matter	0.00E+00	0.00E+00	4.93E-06†	7.43E-04	2.81E-03	3.18E-03	3.33E-03	3.78E-03	3.78E-03	3.67E-03	3.57E-03	3.12E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-07‡	4.73E-07‡	4.72E-06*	1.19E-05	2.86E-05	5.39E-05	7.03E-05	1.44E-04
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E-10‡	1.59E-07‡	4.31E-07†	6.04E-07*	4.96E-07*	7.11E-07
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.53E-08‡	1.26E-06	2.02E-06	5.88E-06	6.97E-06	1.55E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-07‡	7.29E-09‡	1.73E-06*	4.00E-06	1.22E-05	2.14E-05	2.68E-05	5.70E-05
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-07‡	2.33E-06*	7.62E-06	1.40E-05	2.03E-05	2.63E-05	4.40E-05
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.48E-08‡	1.11E-07‡	6.28E-07†	9.03E-07*	8.99E-07*
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-07‡	5.39E-07‡	8.50E-07*	8.83E-07*	2.22E-06*	3.93E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E-06†	5.16E-06	1.74E-05	3.21E-05	4.40E-05	5.64E-05	9.29E-05
Other Tissues	9.02E-05	1.78E-04	2.69E-04	5.85E-04	1.45E-03	4.69E-03	1.48E-02	5.80E-02	1.45E-01	2.32E-01	3.13E-01	5.25E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-08‡	1.87E-06†	2.39E-06	1.09E-05	2.03E-05	3.42E-05	3.65E-05	2.34E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.03E-08†	6.73E-07	2.16E-06	2.52E-06	4.46E-06	7.64E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-06‡	5.69E-06*	1.17E-05	3.72E-05	7.20E-05	9.24E-05	1.21E-04	2.03E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.60E-07*	6.91E-07	1.52E-06*	1.33E-06	2.02E-06
Thyroid	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.95E-01	9.85E-01	9.40E-01	8.48E-01	7.54E-01	6.66E-01	4.11E-01
Trunk	0.00E+00	9.18E-07‡	5.25E-07‡	2.52E-06†	1.10E-05	4.78E-05	1.95E-04	1.11E-03	4.09E-03	8.68E-03	1.44E-02	4.49E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.65E-07‡	2.59E-06*	5.34E-06	1.17E-05	2.23E-05	3.12E-05	6.26E-05

Table A.70: Absorbed Fractions for the 15-year-old Phantom for Sources Located in the White Matter.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.82E-01	9.00E-01	6.29E-01	3.06E-01	1.78E-01	1.76E-01	1.78E-01	1.63E-01	1.46E-01	1.34E-01	1.01E-01
Caud. Nucl.	2.73E-03	6.69E-03	8.70E-03	7.16E-03	3.53E-03	2.01E-03	1.93E-03	1.95E-03	1.81E-03	1.62E-03	1.51E-03	1.16E-03
Cerebellum	1.20E-05*	1.93E-03	8.77E-03	1.65E-02	1.23E-02	7.67E-03	7.16E-03	7.15E-03	6.56E-03	6.07E-03	5.58E-03	4.57E-03
Cereb. Cort.	4.72E-02	1.28E-01	1.81E-01	1.69E-01	9.37E-02	5.57E-02	5.42E-02	5.45E-02	5.04E-02	4.61E-02	4.28E-02	3.40E-02
Cranium	1.21E-04	1.51E-02	7.35E-02	1.54E-01	1.08E-01	3.97E-02	2.44E-02	2.17E-02	1.99E-02	1.84E-02	1.72E-02	1.41E-02
Eyes	0.00E+00	1.00E-06‡	3.68E-05	3.27E-04	5.43E-04	4.70E-04	5.08E-04	4.88E-04	4.75E-04	4.50E-04	4.16E-04	3.42E-04
Lent. Nucl.	3.30E-03	9.02E-03	1.25E-02	1.10E-02	5.84E-03	3.25E-03	3.12E-03	3.09E-03	2.87E-03	2.57E-03	2.44E-03	1.90E-03
Mandible	0.00E+00	1.40E-05	4.72E-04	4.91E-03	1.06E-02	6.73E-03	4.43E-03	3.89E-03	3.62E-03	3.30E-03	3.21E-03	2.74E-03
Other Tissues	1.00E-06‡	1.46E-04	3.35E-03	2.10E-02	3.01E-02	2.49E-02	2.43E-02	2.50E-02	2.37E-02	2.18E-02	2.06E-02	1.70E-02
Skin	0.00E+00	6.39E-05	1.27E-03	5.57E-03	6.00E-03	4.88E-03	5.08E-03	5.45E-03	5.22E-03	4.74E-03	4.34E-03	3.62E-03
Spinal Col.	0.00E+00	0.00E+00	1.00E-05*	5.45E-05	8.55E-05	9.49E-05	9.32E-05	8.16E-05	8.58E-05	6.74E-05	7.46E-05	4.88E-05
Spinal Skel.	0.00E+00	4.00E-06†	2.45E-04	2.85E-03	5.93E-03	3.55E-03	2.25E-03	1.76E-03	1.62E-03	1.51E-03	1.39E-03	1.19E-03
Thalami	2.48E-03	6.85E-03	1.01E-02	9.30E-03	4.90E-03	2.74E-03	2.62E-03	2.61E-03	2.34E-03	2.14E-03	1.97E-03	1.56E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.38E-05	5.08E-05	5.61E-05	6.99E-05	8.22E-05	8.02E-05	7.87E-05	6.86E-05	6.07E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	8.20E-05	8.46E-04	1.85E-03	2.33E-03	3.41E-03	4.40E-03	5.24E-03	5.30E-03	5.91E-03
White Matter	9.38E-01	8.17E-01	6.63E-01	4.01E-01	1.79E-01	1.03E-01	1.03E-01	1.04E-01	9.51E-02	8.47E-02	7.61E-02	5.51E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.74E-01
Caud. Nucl.	6.69E-07‡	5.92E-06*	3.64E-06*	8.85E-06	2.03E-05	6.72E-05	2.21E-04	8.99E-04	2.27E-03	3.62E-03	4.98E-03	8.39E-03
Cerebellum	0.00E+00	0.00E+00	6.18E-07‡	6.60E-07‡	6.15E-07‡	1.78E-06†	4.53E-06	1.85E-05	3.74E-05	5.13E-05	6.54E-05	1.31E-03
Cereb. Cort.	1.78E-05	4.07E-05	6.65E-05	1.36E-04	3.35E-04	1.20E-03	3.68E-03	1.49E-02	3.84E-02	6.39E-02	8.91E-02	1.71E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	1.35E-06‡	3.82E-06*	1.53E-05	4.53E-05	1.09E-04	1.89E-04	2.57E-04	3.20E-04	8.36E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-08‡	0.00E+00	1.09E-06†	2.06E-06	3.30E-06	4.20E-06	8.70E-06
Lent. Nucl.	8.52E-07‡	2.47E-06‡	2.67E-06†	1.22E-05*	3.21E-05	8.73E-05	2.93E-04	1.13E-03	2.89E-03	4.63E-03	6.36E-03	1.13E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-06*	5.27E-06	1.21E-05	2.35E-05	2.98E-05	4.72E-05	8.45E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E-06*	1.30E-05	4.72E-05	1.02E-04	1.67E-04	2.09E-04	5.14E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E-06‡	1.55E-06*	3.26E-06	1.12E-05	1.86E-05	3.84E-05	4.51E-05	1.08E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-08‡	1.42E-07*	6.72E-07	6.35E-07†	1.29E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	6.88E-07‡	0.00E+00	1.06E-06‡	1.34E-06†	5.87E-06	1.23E-05	1.51E-05	2.13E-05	3.02E-05
Thalami	1.34E-06‡	2.39E-06†	3.59E-06†	1.06E-05	1.74E-05	7.19E-05	1.82E-04	8.04E-04	2.09E-03	3.41E-03	4.77E-03	9.02E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.61E-08‡	1.69E-07*	9.76E-07†	9.35E-07*	1.26E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.55E-07†	2.59E-06*	8.87E-06	1.63E-05	2.04E-05	6.26E-05
White Matter	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.79E-01	9.46E-01	9.11E-01	8.77E-01	7.57E-01

Absorbed Fractions of Energy in a Mathematical Model of the Head and Brain of an Adult

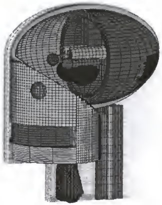


Table A.71: Absorbed Fractions for the Adult Phantom for Sources Located in the Brain (Total).

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.76E-01	9.18E-01	8.18E-01	5.67E-01	2.83E-01	1.67E-01	1.64E-01	1.66E-01	1.53E-01	1.38E-01	1.25E-01	9.42E-02
Caud. Nucl.	7.13E-03	7.11E-03	6.86E-03	5.36E-03	2.73E-03	1.54E-03	1.49E-03	1.46E-03	1.36E-03	1.21E-03	1.11E-03	8.38E-04
Cerebellum	9.10E-02	8.44E-02	7.33E-02	4.86E-02	2.39E-02	1.42E-02	1.42E-02	1.44E-02	1.33E-02	1.18E-02	1.08E-02	8.13E-03
Cereb. Cort.	4.02E-01	3.60E-01	3.06E-01	2.05E-01	1.02E-01	6.13E-02	6.08E-02	6.23E-02	5.71E-02	5.15E-02	4.68E-02	3.52E-02
Cranium	1.28E-02	6.61E-02	1.45E-01	2.14E-01	1.36E-01	4.95E-02	3.17E-02	2.86E-02	2.67E-02	2.42E-02	2.28E-02	1.83E-02
Eyes	0.00E+00	0.00E+00	1.69E-05	2.43E-04	4.84E-04	4.33E-04	4.72E-04	4.63E-04	4.72E-04	4.18E-04	4.06E-04	3.24E-04
Lent. Nucl.	1.30E-02	1.30E-02	1.24E-02	8.95E-03	4.67E-03	2.68E-03	2.61E-03	2.61E-03	2.32E-03	2.17E-03	2.00E-03	1.48E-03
Mandible	0.00E+00	2.09E-05	4.17E-04	4.30E-03	9.74E-03	6.52E-03	4.29E-03	3.71E-03	3.49E-03	3.25E-03	3.09E-03	2.61E-03
Other Tissues	0.00E+00	2.33E-04	3.93E-03	2.21E-02	3.15E-02	2.68E-02	2.67E-02	2.77E-02	2.64E-02	2.46E-02	2.30E-02	1.92E-02
Skin	0.00E+00	1.59E-04	1.86E-03	7.01E-03	7.35E-03	5.81E-03	6.29E-03	6.84E-03	6.52E-03	5.94E-03	5.57E-03	4.51E-03
Spinal Col.	0.00E+00	0.00E+00	7.93E-06*	6.22E-05	1.00E-04	8.98E-05	9.05E-05	9.13E-05	8.18E-05	9.57E-05	7.78E-05	6.82E-05
Spinal Skel.	0.00E+00	1.00E-05*	3.24E-04	3.03E-03	6.17E-03	3.87E-03	2.41E-03	2.04E-03	1.89E-03	1.72E-03	1.67E-03	1.31E-03
Thalami	1.06E-02	1.06E-02	1.02E-02	7.91E-03	4.13E-03	2.39E-03	2.27E-03	2.25E-03	2.02E-03	1.83E-03	1.71E-03	1.29E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.73E-05	7.99E-05	9.53E-05	8.93E-05	1.22E-04	1.23E-04	1.21E-04	1.03E-04	1.02E-04
Trunk	0.00E+00	0.00E+00	0.00E+00	7.44E-05	1.06E-03	2.34E-03	3.15E-03	4.51E-03	6.04E-03	6.73E-03	7.19E-03	7.88E-03
White Matter	4.37E-01	4.29E-01	3.94E-01	2.80E-01	1.39E-01	8.14E-02	7.95E-02	8.02E-02	7.37E-02	6.64E-02	6.06E-02	4.54E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.91E-01	9.78E-01	9.62E-01	9.48E-01	8.88E-01
Caud. Nucl.	7.09E-03	7.17E-03	7.07E-03	7.20E-03	7.12E-03	7.24E-03	7.19E-03	7.18E-03	7.12E-03	6.96E-03	7.13E-03	7.04E-03
Cerebellum	9.50E-02	9.47E-02	9.47E-02	9.48E-02	9.46E-02	9.51E-02	9.47E-02	9.33E-02	9.19E-02	8.96E-02	8.82E-02	8.16E-02
Cereb. Cort.	4.23E-01	4.23E-01	4.24E-01	4.24E-01	4.24E-01	4.23E-01	4.22E-01	4.17E-01	4.06E-01	3.94E-01	3.81E-01	3.36E-01
Cranium	0.00E+00	5.85E-07‡	0.00E+00	3.52E-06*	9.69E-06*	2.99E-05	6.00E-05	3.12E-04	6.86E-03	1.82E-02	3.03E-02	6.70E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.98E-08‡	2.06E-09‡	1.04E-06*	1.72E-06	3.05E-06	4.09E-06	1.04E-05
Lent. Nucl.	1.30E-02	1.31E-02	1.29E-02	1.30E-02	1.30E-02	1.29E-02	1.30E-02	1.29E-02	1.31E-02	1.29E-02	1.30E-02	1.28E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-06‡	3.09E-06	9.00E-06	2.43E-05	3.23E-05	4.16E-05	2.39E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-07‡	6.51E-06	1.32E-05	4.73E-05	1.15E-04	1.80E-04	2.47E-04	4.11E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-06†	3.22E-06	1.19E-05	2.69E-05	3.70E-05	6.26E-05	3.99E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-08‡	2.16E-07*	7.29E-07*	3.99E-07*	1.85E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.83E-06†	1.99E-06*	6.03E-06	1.38E-05	2.01E-05	2.19E-05	1.83E-04
Thalami	1.09E-02	1.07E-02	1.06E-02	1.05E-02	1.06E-02	1.06E-02	1.08E-02	1.06E-02	1.06E-02	1.07E-02	1.06E-02	1.05E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.37E-08‡	3.97E-07*	4.35E-07*	1.05E-06	1.47E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.97E-07‡	5.07E-07†	3.45E-06	1.30E-05	2.59E-05	3.69E-05	8.54E-05
White Matter	4.36E-01	4.37E-01	4.36E-01	4.36E-01	4.36E-01	4.36E-01	4.36E-01	4.35E-01	4.34E-01	4.33E-01	4.33E-01	4.26E-01

Table A.72: Absorbed Fractions for the Adult Phantom for Sources Located in the Caudate Nuclei.

Photon Absorbed Fraction of Energy: ϕ

Targets	Energy (MeV)											
	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.98E-01	9.65E-01	7.29E-01	3.70E-01	2.15E-01	2.08E-01	2.08E-01	1.90E-01	1.72E-01	1.56E-01	1.19E-01
Caud. Nucl.	8.09E-01	5.07E-01	2.87E-01	1.06E-01	3.37E-02	1.96E-02	2.16E-02	2.27E-02	1.96E-02	1.59E-02	1.31E-02	6.45E-03
Cerebellum	0.00E+00	2.59E-05*	1.08E-03	6.96E-03	7.87E-03	5.46E-03	4.86E-03	4.69E-03	4.35E-03	4.12E-03	3.67E-03	3.06E-03
Cereb. Cort.	1.20E-05	5.76E-03	4.36E-02	1.02E-01	7.72E-02	4.75E-02	4.39E-02	4.29E-02	3.91E-02	3.62E-02	3.34E-02	2.72E-02
Cranium	0.00E+00	1.39E-03	2.63E-02	1.18E-01	1.11E-01	4.52E-02	2.66E-02	2.25E-02	2.05E-02	1.89E-02	1.76E-02	1.45E-02
Eyes	0.00E+00	0.00E+00	7.97E-06*	3.42E-04	7.00E-04	6.71E-04	7.03E-04	6.83E-04	6.76E-04	5.92E-04	5.67E-04	4.51E-04
Lent. Nucl.	3.78E-02	7.58E-02	7.58E-02	4.40E-02	1.74E-02	9.85E-03	9.94E-03	1.02E-02	9.42E-03	8.51E-03	7.67E-03	5.61E-03
Mandible	0.00E+00	1.00E-06‡	3.08E-04	5.65E-03	1.35E-02	8.98E-03	5.71E-03	4.89E-03	4.53E-03	4.13E-03	3.95E-03	3.31E-03
Other Tissues	0.00E+00	1.20E-05	1.34E-03	1.77E-02	3.31E-02	2.95E-02	2.82E-02	2.85E-02	2.70E-02	2.50E-02	2.34E-02	1.96E-02
Skin	0.00E+00	1.00E-06‡	2.63E-04	3.66E-03	5.68E-03	5.03E-03	5.16E-03	5.67E-03	5.40E-03	4.99E-03	4.60E-03	3.77E-03
Spinal Col.	0.00E+00	0.00E+00	1.98E-06‡	3.18E-05	6.93E-05	7.06E-05	7.44E-05	6.32E-05	5.55E-05	5.17E-05	3.92E-05	4.71E-05
Spinal Skel.	0.00E+00	0.00E+00	2.86E-05	1.37E-03	4.52E-03	3.32E-03	1.99E-03	1.47E-03	1.31E-03	1.19E-03	1.13E-03	9.00E-04
Thalami	4.34E-03	1.91E-02	2.72E-02	2.09E-02	9.57E-03	5.29E-03	5.16E-03	5.18E-03	4.69E-03	4.40E-03	3.96E-03	3.04E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	2.97E-05	1.08E-04	1.23E-04	1.34E-04	1.43E-04	1.43E-04	1.26E-04	1.29E-04	1.12E-04
Trunk	0.00E+00	0.00E+00	0.00E+00	7.94E-05	1.37E-03	2.77E-03	3.55E-03	5.18E-03	6.82E-03	7.67E-03	8.17E-03	8.96E-03
White Matter	1.45E-01	3.62E-01	4.88E-01	4.17E-01	2.11E-01	1.20E-01	1.15E-01	1.14E-01	1.06E-01	9.62E-02	8.83E-02	6.86E-02

Electron Absorbed Fraction of Energy: ϕ

Targets	Energy (MeV)											
	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.95E-01	9.84E-01	9.38E-01	8.39E-01	7.32E-01	6.31E-01	3.38E-01
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.25E-07†	2.58E-06	1.34E-05	2.08E-05	3.50E-05	4.50E-05	8.25E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	2.17E-06†	3.42E-06*	1.52E-05	3.40E-05	1.01E-04	2.24E-04	3.29E-04	4.14E-04	1.40E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	6.28E-07‡	3.79E-06*	2.01E-05	4.26E-05	1.01E-04	1.85E-04	2.48E-04	3.03E-04	4.90E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.97E-07‡	6.30E-07‡	1.14E-06*	2.81E-06	4.37E-06	6.03E-06	9.34E-06
Lent. Nucl.	2.51E-05	4.61E-05	6.40E-05	1.25E-04	3.02E-04	1.05E-03	3.33E-03	1.28E-02	3.21E-02	5.17E-02	6.85E-02	1.02E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-06‡	5.50E-06	1.42E-05	2.98E-05	4.10E-05	5.13E-05	9.31E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.26E-07‡	3.75E-06*	1.38E-05	5.31E-05	1.16E-04	1.83E-04	2.36E-04	4.64E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.97E-07‡	2.35E-06	7.30E-06	2.12E-05	3.22E-05	4.83E-05	9.28E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.37E-08†	1.89E-07*	5.10E-07*	6.54E-07†	1.04E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.60E-07‡	1.40E-06*	5.36E-06	1.05E-05	1.40E-05	2.13E-05	2.89E-05
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E-06†	4.97E-06*	7.99E-06	2.21E-04	2.08E-03	5.79E-03	1.07E-02	2.91E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-08‡	2.56E-07†	2.85E-07*	8.23E-07*	8.80E-07	2.37E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.37E-07‡	1.20E-06†	5.23E-06	1.62E-05	2.51E-05	4.41E-05	9.71E-05
White Matter	7.44E-05	1.07E-04	2.04E-04	4.95E-04	1.17E-03	3.88E-03	1.20E-02	4.78E-02	1.23E-01	2.00E-01	2.70E-01	4.69E-01

Table A.73: Absorbed Fractions for the Adult Phantom for Sources Located in the Cerebellum.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.68E-01	8.94E-01	7.75E-01	5.17E-01	2.53E-01	1.51E-01	1.49E-01	1.52E-01	1.39E-01	1.25E-01	1.14E-01	8.46E-02
Caud. Nucl.	0.00E+00	5.99E-06*	9.81E-05	5.20E-04	5.98E-04	3.87E-04	3.77E-04	3.56E-04	3.16E-04	2.90E-04	2.86E-04	2.38E-04
Cerebellum	9.34E-01	7.92E-01	6.00E-01	3.08E-01	1.16E-01	6.64E-02	6.93E-02	7.20E-02	6.51E-02	5.75E-02	5.11E-02	3.46E-02
Cereb. Cort.	3.45E-02	9.47E-02	1.36E-01	1.31E-01	7.45E-02	4.53E-02	4.39E-02	4.43E-02	4.10E-02	3.78E-02	3.50E-02	2.75E-02
Cranium	1.62E-02	8.49E-02	1.81E-01	2.46E-01	1.47E-01	5.17E-02	3.37E-02	3.07E-02	2.84E-02	2.64E-02	2.43E-02	1.96E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	8.95E-06*	6.28E-05	1.01E-04	1.08E-04	1.21E-04	1.29E-04	1.23E-04	1.18E-04	1.04E-04
Lent. Nucl.	0.00E+00	9.92E-07‡	1.49E-04	9.61E-04	1.13E-03	8.17E-04	7.11E-04	6.80E-04	6.20E-04	5.74E-04	5.62E-04	4.34E-04
Mandible	0.00E+00	0.00E+00	6.78E-06*	8.82E-04	4.58E-03	3.78E-03	2.51E-03	2.23E-03	2.14E-03	2.06E-03	1.95E-03	1.76E-03
Other Tissues	0.00E+00	4.26E-04	6.94E-03	3.29E-02	4.07E-02	3.29E-02	3.27E-02	3.41E-02	3.27E-02	3.03E-02	2.84E-02	2.34E-02
Skin	0.00E+00	1.21E-04	2.02E-03	7.86E-03	7.55E-03	5.89E-03	6.35E-03	6.88E-03	6.59E-03	6.07E-03	5.51E-03	4.51E-03
Spinal Col.	0.00E+00	0.00E+00	5.96E-06*	7.21E-05	1.53E-04	1.48E-04	1.52E-04	1.62E-04	1.57E-04	1.51E-04	1.28E-04	1.15E-04
Spinal Skel.	0.00E+00	1.01E-05	3.48E-04	5.29E-03	1.08E-02	6.28E-03	4.10E-03	3.55E-03	3.39E-03	3.15E-03	3.04E-03	2.41E-03
Thalami	0.00E+00	7.99E-06	3.66E-04	1.65E-03	1.63E-03	9.84E-04	9.33E-04	8.85E-04	7.91E-04	7.61E-04	6.82E-04	5.36E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	2.41E-06†	5.43E-05	8.06E-05	9.41E-05	1.05E-04	1.19E-04	1.12E-04	1.17E-04	9.72E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	5.63E-05	1.01E-03	2.45E-03	3.25E-03	4.76E-03	6.16E-03	6.88E-03	7.51E-03	7.63E-03
White Matter	3.40E-05	8.20E-03	3.74E-02	7.30E-02	5.66E-02	3.55E-02	3.26E-02	3.23E-02	2.97E-02	2.76E-02	2.54E-02	2.06E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.89E-01	9.71E-01	9.51E-01	9.32E-01	8.58E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.26E-07*	1.38E-06	2.76E-06	3.52E-06	5.05E-06
Cerebellum	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.94E-01	9.77E-01	9.42E-01	9.04E-01	8.66E-01	7.27E-01
Cereb. Cort.	1.46E-05	3.24E-05	6.05E-05	1.04E-04	2.85E-04	9.24E-04	2.89E-03	1.10E-02	2.86E-02	4.72E-02	6.58E-02	1.26E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	3.44E-06*	1.25E-05	2.77E-05	6.54E-05	2.80E-04	8.69E-03	2.37E-02	4.00E-02	8.87E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-07‡	8.08E-08‡	3.72E-07*	9.50E-07*	8.68E-07	2.61E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.76E-07‡	3.72E-07‡	1.15E-06*	3.72E-06	4.89E-06	6.41E-06	1.25E-05
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-07‡	1.96E-06*	6.72E-06	1.01E-05	1.89E-05	2.43E-05	3.82E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.07E-08‡	4.31E-06*	1.82E-05	6.48E-05	1.42E-04	2.27E-04	3.03E-04	9.03E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.40E-08‡	4.64E-07‡	3.18E-06	1.32E-05	2.58E-05	4.47E-05	5.74E-05	3.56E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.88E-08†	4.10E-07	4.86E-07*	1.12E-06	3.08E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.03E-08‡	6.89E-07‡	3.67E-06*	1.33E-05	2.13E-05	3.13E-05	4.25E-05	1.91E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.74E-07†	2.65E-06	3.32E-06	6.11E-06	8.60E-06	1.70E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E-07‡	1.28E-07‡	5.25E-07*	6.26E-07*	1.42E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.78E-09‡	5.12E-07‡	4.55E-06	1.52E-05	2.06E-05	3.35E-05	9.04E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.51E-06†	9.13E-06	2.84E-05	7.67E-05	1.68E-04	2.41E-04	3.19E-04	5.41E-03

Table A.74: Absorbed Fractions for the Adult Phantom for Sources Located in the Cerebral Cortex.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	9.50E-01	8.48E-01	7.23E-01	4.84E-01	2.42E-01	1.45E-01	1.44E-01	1.46E-01	1.34E-01	1.22E-01	1.10E-01	8.25E-02
Caud. Nucl.	1.00E-06‡	8.71E-05	7.85E-04	1.72E-03	1.32E-03	7.89E-04	7.68E-04	7.32E-04	6.59E-04	5.93E-04	5.48E-04	4.48E-04
Cerebellum	7.82E-03	2.10E-02	3.05E-02	2.93E-02	1.67E-02	1.00E-02	9.71E-03	9.81E-03	9.16E-03	8.44E-03	7.96E-03	6.35E-03
Cereb. Cort.	8.97E-01	7.01E-01	5.07E-01	2.73E-01	1.19E-01	7.13E-02	7.31E-02	7.56E-02	6.86E-02	6.14E-02	5.46E-02	3.84E-02
Cranium	2.61E-02	1.22E-01	2.22E-01	2.64E-01	1.50E-01	5.27E-02	3.47E-02	3.24E-02	3.01E-02	2.76E-02	2.55E-02	2.03E-02
Eyes	0.00E+00	0.00E+00	1.83E-05*	2.56E-04	4.48E-04	4.22E-04	4.61E-04	4.80E-04	4.33E-04	4.12E-04	4.08E-04	3.25E-04
Lent. Nucl.	1.70E-05	6.35E-04	1.93E-03	3.23E-03	2.40E-03	1.47E-03	1.36E-03	1.33E-03	1.20E-03	1.13E-03	9.77E-04	8.40E-04
Mandible	0.00E+00	4.28E-05	6.40E-04	4.58E-03	9.34E-03	6.11E-03	4.04E-03	3.61E-03	3.39E-03	3.19E-03	3.03E-03	2.54E-03
Other Tissues	0.00E+00	3.54E-04	4.88E-03	2.19E-02	3.00E-02	2.53E-02	2.51E-02	2.61E-02	2.52E-02	2.36E-02	2.21E-02	1.84E-02
Skin	0.00E+00	2.62E-04	2.73E-03	8.51E-03	7.90E-03	6.26E-03	6.77E-03	7.41E-03	7.15E-03	6.52E-03	5.92E-03	4.79E-03
Spinal Col.	0.00E+00	9.75E-07‡	1.12E-05*	5.82E-05	9.01E-05	8.22E-05	9.13E-05	9.72E-05	8.05E-05	8.56E-05	7.33E-05	6.85E-05
Spinal Skel.	0.00E+00	3.30E-05	3.91E-04	3.27E-03	5.86E-03	3.48E-03	2.26E-03	1.91E-03	1.83E-03	1.64E-03	1.57E-03	1.29E-03
Thalami	0.00E+00	2.19E-04	1.23E-03	2.56E-03	1.99E-03	1.23E-03	1.10E-03	1.06E-03	9.79E-04	9.05E-04	8.12E-04	6.92E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.59E-05	7.01E-05	8.57E-05	1.02E-04	1.04E-04	1.12E-04	1.10E-04	1.18E-04	9.46E-05
Trunk	0.00E+00	0.00E+00	0.00E+00	8.07E-05	9.54E-04	2.13E-03	2.85E-03	4.11E-03	5.40E-03	6.25E-03	6.56E-03	7.20E-03
White Matter	4.55E-02	1.24E-01	1.78E-01	1.70E-01	9.73E-02	5.79E-02	5.61E-02	5.61E-02	5.16E-02	4.77E-02	4.39E-02	3.46E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.96E-01	9.83E-01	9.57E-01	9.29E-01	8.99E-01	7.94E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-08‡	1.94E-07†	2.35E-06	3.11E-06	5.07E-06	7.38E-06	1.98E-05
Cerebellum	6.04E-06*	6.55E-06*	1.52E-05	3.06E-05	6.12E-05	2.04E-04	6.30E-04	2.45E-03	6.44E-03	1.06E-02	1.45E-02	2.81E-02
Cereb. Cort.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.92E-01	9.67E-01	9.14E-01	8.56E-01	7.98E-01	5.98E-01
Cranium	0.00E+00	0.00E+00	7.02E-07‡	3.68E-06*	1.05E-05	3.51E-05	7.38E-05	5.38E-04	1.41E-02	3.70E-02	6.24E-02	1.31E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E-08‡	1.23E-07*	6.49E-07	2.09E-06*	3.36E-06	3.99E-06	1.38E-05
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-07‡	1.36E-06*	3.65E-06	6.15E-06	1.64E-05	5.51E-05	7.25E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.60E-07†	3.86E-06*	1.07E-05	2.07E-05	2.69E-05	4.03E-05	4.79E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.11E-07‡	4.97E-06	1.27E-05	4.72E-05	1.12E-04	1.70E-04	2.60E-04	7.33E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E-08‡	1.02E-06†	3.09E-06	1.29E-05	2.87E-05	4.75E-05	7.02E-05	8.57E-03
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.92E-08‡	0.00E+00	2.23E-07†	6.01E-07*	3.27E-07*	7.22E-07*	2.19E-05
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.69E-07‡	2.31E-06	6.81E-06	1.39E-05	1.56E-05	2.30E-05	3.94E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.15E-07‡	8.24E-07‡	4.70E-07†	2.80E-06	5.87E-06	7.82E-06	1.10E-05	7.88E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.02E-08‡	1.70E-07‡	2.34E-07‡	4.38E-07*	8.07E-07*	7.56E-07
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-06†	4.72E-06*	1.12E-05	1.78E-05	2.93E-05	8.37E-05
White Matter	2.10E-05	5.03E-05	7.37E-05	1.43E-04	3.31E-04	1.12E-03	3.55E-03	1.42E-02	3.68E-02	6.16E-02	8.65E-02	1.65E-01

Table A.75: Absorbed Fractions for the Adult Phantom for Sources Located in the Cranial CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	2.95E-01	3.79E-01	3.77E-01	2.95E-01	1.64E-01	1.03E-01	1.02E-01	1.05E-01	9.71E-02	8.85E-02	8.11E-02	6.29E-02
Caud. Nucl.	0.00E+00	2.30E-05	3.38E-04	1.00E-03	8.29E-04	6.06E-04	5.42E-04	5.30E-04	5.05E-04	4.53E-04	4.15E-04	3.53E-04
Cerebellum	3.85E-02	4.87E-02	4.64E-02	3.25E-02	1.68E-02	1.04E-02	1.06E-02	1.08E-02	1.00E-02	9.17E-03	8.37E-03	6.32E-03
Cereb. Cort.	2.56E-01	3.05E-01	2.61E-01	1.63E-01	7.95E-02	4.91E-02	5.02E-02	5.23E-02	4.86E-02	4.40E-02	4.00E-02	3.00E-02
Cranium	3.14E-01	4.41E-01	4.83E-01	4.01E-01	1.92E-01	6.46E-02	4.59E-02	4.49E-02	4.15E-02	3.77E-02	3.40E-02	2.42E-02
Eyes	0.00E+00	1.00E-06‡	3.19E-05	2.45E-04	4.20E-04	4.12E-04	4.51E-04	4.70E-04	4.44E-04	4.48E-04	4.01E-04	3.34E-04
Lent. Nucl.	0.00E+00	2.11E-04	1.13E-03	2.18E-03	1.72E-03	1.14E-03	1.07E-03	1.05E-03	9.28E-04	8.90E-04	8.06E-04	6.50E-04
Mandible	0.00E+00	7.88E-05	8.62E-04	5.36E-03	9.95E-03	6.30E-03	4.26E-03	3.79E-03	3.67E-03	3.46E-03	3.24E-03	2.72E-03
Other Tissues	1.00E-06‡	9.03E-04	8.09E-03	2.81E-02	3.37E-02	2.82E-02	2.88E-02	3.02E-02	2.92E-02	2.70E-02	2.55E-02	2.07E-02
Skin	0.00E+00	6.20E-04	4.15E-03	1.02E-02	9.00E-03	7.04E-03	7.80E-03	8.64E-03	8.17E-03	7.58E-03	6.95E-03	5.48E-03
Spinal Col.	0.00E+00	1.00E-06‡	1.72E-05	5.86E-05	1.03E-04	9.44E-05	9.62E-05	1.02E-04	9.79E-05	1.04E-04	8.00E-05	6.58E-05
Spinal Skel.	0.00E+00	4.53E-05	6.35E-04	4.13E-03	6.87E-03	3.96E-03	2.55E-03	2.25E-03	2.12E-03	1.96E-03	1.84E-03	1.52E-03
Thalami	0.00E+00	7.49E-05	5.39E-04	1.57E-03	1.41E-03	9.16E-04	8.69E-04	8.09E-04	7.23E-04	6.85E-04	6.35E-04	5.41E-04
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.21E-05*	7.21E-05	8.30E-05	1.01E-04	1.14E-04	1.12E-04	1.02E-04	1.08E-04	1.13E-04
Trunk	0.00E+00	0.00E+00	0.00E+00	7.75E-05	1.00E-03	2.25E-03	2.91E-03	4.20E-03	5.41E-03	6.32E-03	6.67E-03	7.08E-03
White Matter	5.69E-04	2.48E-02	6.71E-02	9.23E-02	6.24E-02	3.95E-02	3.77E-02	3.81E-02	3.54E-02	3.25E-02	3.01E-02	2.44E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	2.29E-04	5.21E-04	8.74E-04	1.85E-03	4.54E-03	1.51E-02	4.72E-02	1.85E-01	3.25E-01	3.74E-01	3.96E-01	4.18E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.19E-08‡	3.91E-07†	1.36E-06*	2.68E-06	4.24E-06	4.10E-06	9.35E-06
Cerebellum	2.01E-05	6.43E-05	1.15E-04	2.33E-04	6.16E-04	1.88E-03	5.98E-03	2.37E-02	4.26E-02	4.88E-02	5.16E-02	5.30E-02
Cereb. Cort.	2.09E-04	4.56E-04	7.59E-04	1.61E-03	3.92E-03	1.32E-02	4.12E-02	1.62E-01	2.82E-01	3.25E-01	3.44E-01	3.31E-01
Cranium	2.19E-04	5.32E-04	8.77E-04	1.86E-03	4.57E-03	1.53E-02	4.77E-02	1.87E-01	3.32E-01	3.87E-01	4.12E-01	3.38E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-07‡	1.71E-07‡	9.72E-07†	2.48E-06	3.79E-06	4.88E-06	4.58E-05
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.45E-07‡	4.93E-07†	6.30E-07†	2.77E-06	6.19E-06	9.18E-06	9.54E-06	1.50E-04
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.98E-07‡	4.86E-07‡	2.91E-06	1.17E-05	2.36E-05	3.97E-05	1.41E-04	1.52E-03
Other Tissues	0.00E+00	0.00E+00	0.00E+00	7.01E-07‡	6.45E-07‡	4.98E-06	1.49E-05	5.90E-05	1.32E-04	2.21E-04	1.15E-03	3.19E-02
Skin	0.00E+00	0.00E+00	0.00E+00	5.16E-07‡	0.00E+00	4.45E-07*	4.22E-06	1.47E-05	3.69E-05	6.01E-05	6.27E-04	2.94E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.37E-08‡	1.37E-07‡	7.35E-07*	3.56E-07*	1.46E-06*	1.00E-04
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.31E-07‡	3.66E-06	7.65E-06	1.33E-05	2.09E-05	3.97E-05	1.57E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E-08‡	9.33E-08‡	9.05E-07*	1.58E-06	5.21E-06	6.03E-06	6.52E-06	1.43E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-08‡	3.54E-07*	2.81E-07*	7.17E-07	1.35E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-07‡	4.56E-06	1.22E-05	2.31E-05	3.77E-05	8.31E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	1.26E-06‡	3.09E-06*	1.02E-05	2.92E-05	1.05E-04	2.11E-04	3.06E-04	5.80E-04	3.41E-02

Table A.76: Absorbed Fractions for the Adult Phantom for Sources Located in the Cranium.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.13E-02	5.46E-02	1.16E-01	1.71E-01	1.26E-01	8.44E-02	8.46E-02	8.68E-02	8.10E-02	7.51E-02	6.94E-02	5.60E-02
Caud. Nucl.	0.00E+00	1.19E-05	1.24E-04	7.43E-04	7.25E-04	5.03E-04	4.69E-04	4.77E-04	4.55E-04	3.99E-04	3.97E-04	3.08E-04
Cerebellum	1.37E-03	6.63E-03	1.37E-02	1.86E-02	1.31E-02	8.46E-03	8.50E-03	8.73E-03	8.11E-03	7.63E-03	7.02E-03	5.72E-03
Cereb. Cort.	9.88E-03	4.28E-02	7.50E-02	8.87E-02	5.81E-02	3.87E-02	4.01E-02	4.16E-02	3.89E-02	3.61E-02	3.33E-02	2.64E-02
Cranium	9.53E-01	8.51E-01	7.04E-01	4.55E-01	2.06E-01	6.99E-02	5.16E-02	5.10E-02	4.61E-02	4.02E-02	3.58E-02	2.47E-02
Eyes	0.00E+00	1.05E-06‡	5.59E-05	2.58E-04	4.65E-04	4.17E-04	4.67E-04	4.96E-04	4.74E-04	4.59E-04	4.01E-04	3.55E-04
Lent. Nucl.	0.00E+00	6.20E-05	4.37E-04	1.45E-03	1.40E-03	1.00E-03	9.25E-04	9.52E-04	8.69E-04	8.12E-04	7.08E-04	5.87E-04
Mandible	2.30E-04	1.05E-03	2.85E-03	7.11E-03	1.02E-02	6.26E-03	4.33E-03	3.88E-03	3.70E-03	3.41E-03	3.29E-03	2.76E-03
Other Tissues	7.32E-03	1.88E-02	3.02E-02	3.86E-02	3.58E-02	2.95E-02	3.03E-02	3.16E-02	3.05E-02	2.86E-02	2.70E-02	2.14E-02
Skin	1.09E-02	1.75E-02	1.90E-02	1.65E-02	1.04E-02	8.01E-03	9.11E-03	1.01E-02	9.47E-03	8.56E-03	7.84E-03	5.76E-03
Spinal Col.	2.60E-05	5.20E-05	6.65E-05	9.58E-05	1.22E-04	9.71E-05	1.07E-04	9.90E-05	1.10E-04	1.06E-04	9.82E-05	8.51E-05
Spinal Skel.	3.53E-04	1.16E-03	2.63E-03	5.87E-03	7.33E-03	4.07E-03	2.69E-03	2.40E-03	2.19E-03	2.12E-03	1.94E-03	1.61E-03
Thalami	0.00E+00	2.20E-05	2.25E-04	1.06E-03	1.17E-03	8.17E-04	7.58E-04	7.25E-04	6.61E-04	6.40E-04	6.00E-04	5.13E-04
Thyroid	0.00E+00	0.00E+00	2.00E-06‡	2.98E-05	7.19E-05	9.68E-05	1.06E-04	1.18E-04	1.27E-04	1.21E-04	1.17E-04	1.01E-04
Trunk	0.00E+00	0.00E+00	9.97E-07‡	9.65E-05	1.01E-03	2.22E-03	2.81E-03	4.17E-03	5.34E-03	6.06E-03	6.41E-03	6.93E-03
White Matter	5.10E-05	5.09E-03	2.60E-02	5.91E-02	5.02E-02	3.39E-02	3.29E-02	3.34E-02	3.11E-02	2.88E-02	2.66E-02	2.19E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	1.85E-06‡	7.44E-06†	3.68E-05	8.21E-05	7.15E-04	2.08E-02	5.51E-02	9.34E-02	2.08E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.63E-08‡	7.06E-07‡	1.32E-06*	2.52E-06	3.29E-06	5.46E-06	9.37E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	7.82E-07‡	2.27E-06†	2.38E-06*	9.46E-06	5.52E-05	2.44E-03	6.78E-03	1.15E-02	2.59E-02
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	4.55E-07‡	1.43E-06*	1.98E-05	3.92E-05	5.53E-04	1.82E-02	4.80E-02	8.15E-02	1.71E-01
Cranium	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.96E-01	9.87E-01	9.49E-01	8.69E-01	7.79E-01	6.89E-01	4.42E-01
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.34E-08†	1.11E-06	3.44E-06	4.67E-06	6.18E-06	1.36E-04
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.83E-07‡	2.32E-07‡	3.27E-06	4.80E-06	8.13E-06	1.15E-05	4.87E-05
Mandible	0.00E+00	0.00E+00	2.17E-06†	2.39E-06†	4.40E-06*	1.61E-05	6.89E-05	2.15E-04	5.72E-04	1.03E-03	1.55E-03	3.29E-03
Other Tissues	1.44E-05	2.57E-05	3.80E-05	9.35E-05	2.15E-04	7.20E-04	2.23E-03	8.32E-03	2.02E-02	3.27E-02	4.42E-02	6.79E-02
Skin	1.69E-05	4.04E-05	5.42E-05	1.43E-04	3.73E-04	1.17E-03	3.56E-03	1.45E-02	3.67E-02	5.09E-02	5.85E-02	5.54E-02
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.25E-06*	2.20E-05	5.32E-05	8.32E-05	1.31E-04	2.22E-04
Spinal Skel.	0.00E+00	0.00E+00	4.41E-06†	1.98E-06†	9.54E-06*	2.58E-05	7.23E-05	3.33E-04	8.84E-04	1.47E-03	2.04E-03	3.57E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.41E-07‡	1.56E-06*	1.56E-06	5.50E-06	7.27E-06	8.38E-06	1.43E-05
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.55E-07†	5.47E-07	9.36E-07*	1.43E-06	1.95E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-07‡	1.02E-06†	5.10E-06	1.78E-05	2.34E-05	3.68E-05	8.72E-05
White Matter	0.00E+00	0.00E+00	0.00E+00	6.16E-07‡	3.74E-06†	1.35E-05	3.00E-05	9.80E-05	1.96E-04	2.95E-04	3.68E-04	1.06E-02

Table A.77: Absorbed Fractions for the Adult Phantom for Sources Located in the Lateral Ventricles.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	9.82E-01	7.73E-01	4.00E-01	2.30E-01	2.21E-01	2.21E-01	2.02E-01	1.82E-01	1.67E-01	1.27E-01
Caud. Nucl.	2.23E-03	1.48E-02	2.13E-02	1.59E-02	7.04E-03	3.88E-03	3.83E-03	3.90E-03	3.40E-03	3.27E-03	2.99E-03	2.31E-03
Cerebellum	1.00E-06‡	3.88E-04	4.86E-03	1.61E-02	1.42E-02	8.79E-03	8.00E-03	7.78E-03	7.06E-03	6.63E-03	6.12E-03	4.96E-03
Cereb. Cort.	2.69E-03	3.24E-02	8.60E-02	1.37E-01	9.49E-02	5.67E-02	5.27E-02	5.13E-02	4.75E-02	4.34E-02	4.06E-02	3.26E-02
Cranium	0.00E+00	2.09E-04	1.37E-02	9.92E-02	1.07E-01	4.42E-02	2.57E-02	2.14E-02	1.95E-02	1.79E-02	1.68E-02	1.42E-02
Eyes	0.00E+00	0.00E+00	2.00E-06‡	1.13E-04	3.60E-04	3.73E-04	3.94E-04	3.91E-04	3.81E-04	3.73E-04	3.49E-04	2.76E-04
Lent. Nucl.	7.32E-04	7.44E-03	1.61E-02	1.70E-02	8.62E-03	4.89E-03	4.59E-03	4.59E-03	4.18E-03	3.71E-03	3.48E-03	2.76E-03
Mandible	0.00E+00	0.00E+00	7.71E-05	3.18E-03	9.64E-03	6.86E-03	4.36E-03	3.63E-03	3.34E-03	3.17E-03	3.05E-03	2.52E-03
Other Tissues	0.00E+00	2.95E-06†	5.76E-04	1.39E-02	2.85E-02	2.59E-02	2.48E-02	2.52E-02	2.39E-02	2.25E-02	2.11E-02	1.75E-02
Skin	0.00E+00	1.00E-06‡	2.37E-04	3.60E-03	5.82E-03	4.88E-03	5.22E-03	5.55E-03	5.29E-03	4.88E-03	4.52E-03	3.71E-03
Spinal Col.	0.00E+00	0.00E+00	2.95E-06†	3.75E-05	8.82E-05	8.73E-05	8.83E-05	8.41E-05	6.87E-05	6.69E-05	6.97E-05	5.90E-05
Spinal Skel.	0.00E+00	0.00E+00	4.26E-05	1.72E-03	5.28E-03	3.70E-03	2.29E-03	1.83E-03	1.67E-03	1.59E-03	1.41E-03	1.22E-03
Thalami	1.89E-03	1.28E-02	2.34E-02	2.08E-02	9.81E-03	5.37E-03	5.22E-03	5.29E-03	4.66E-03	4.28E-03	3.97E-03	3.23E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.64E-05	9.57E-05	1.06E-04	1.13E-04	1.20E-04	1.06E-04	1.09E-04	1.22E-04	1.04E-04
Trunk	0.00E+00	0.00E+00	0.00E+00	6.49E-05	1.14E-03	2.49E-03	3.25E-03	4.95E-03	6.51E-03	7.44E-03	8.04E-03	8.81E-03
White Matter	1.41E-01	3.33E-01	4.50E-01	4.07E-01	2.12E-01	1.20E-01	1.15E-01	1.14E-01	1.04E-01	9.52E-02	8.76E-02	6.85E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	5.92E-07‡	1.21E-06†	1.51E-06*	5.46E-06	1.32E-05	2.81E-04	2.40E-03	6.21E-03	2.40E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E-07‡	2.35E-06*	4.91E-06	2.00E-05	4.05E-05	5.75E-05	7.47E-05	1.35E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	8.84E-07‡	3.39E-06*	1.98E-05	5.26E-05	1.38E-04	4.17E-04	2.70E-03	7.50E-03	4.26E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	1.32E-08‡	2.23E-06†	1.25E-05	3.54E-05	9.86E-05	1.74E-04	2.47E-04	2.90E-04	4.63E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.71E-07‡	2.31E-07‡	7.64E-07†	1.51E-06	2.06E-06	3.45E-06	6.35E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	9.48E-07‡	1.36E-09‡	1.62E-06*	5.22E-06	1.32E-05	9.91E-05	8.42E-04	2.09E-03	9.38E-03
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-08‡	4.53E-07‡	3.30E-06*	9.00E-06	2.13E-05	3.20E-05	3.86E-05	6.86E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-06‡	2.34E-06*	1.05E-05	4.60E-05	1.06E-04	1.68E-04	2.20E-04	4.10E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.35E-07‡	8.64E-07†	2.35E-06	9.66E-06	2.49E-05	3.48E-05	4.62E-05	9.34E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.04E-07‡	3.44E-07†	6.88E-07*	9.35E-07	1.59E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.56E-07‡	8.11E-07‡	4.64E-06	1.22E-05	1.66E-05	2.27E-05	3.47E-05
Thalami	0.00E+00	0.00E+00	8.23E-07‡	4.06E-07‡	5.18E-08‡	3.10E-06*	7.08E-06	1.37E-04	9.25E-04	2.48E-03	4.87E-03	1.71E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.45E-08‡	6.39E-07*	9.76E-07	1.29E-06*	3.10E-06*
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-06†	4.63E-06*	1.28E-05	2.41E-05	3.84E-05	8.70E-05
White Matter	5.91E-05	1.31E-04	2.06E-04	4.99E-04	1.20E-03	3.85E-03	1.19E-02	4.71E-02	1.21E-01	1.95E-01	2.61E-01	4.28E-01

Table A.78: Absorbed Fractions for the Adult Phantom for Sources Located in the Lentiform Nuclei.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.94E-01	9.41E-01	6.95E-01	3.55E-01	2.08E-01	2.01E-01	2.00E-01	1.82E-01	1.65E-01	1.50E-01	1.14E-01
Caud. Nucl.	2.04E-02	4.19E-02	4.14E-02	2.40E-02	9.48E-03	5.33E-03	5.37E-03	5.57E-03	5.14E-03	4.66E-03	4.25E-03	3.00E-03
Cerebellum	0.00E+00	1.89E-05	1.03E-03	7.00E-03	8.31E-03	5.76E-03	5.20E-03	5.05E-03	4.56E-03	4.34E-03	3.95E-03	3.25E-03
Cereb. Cort.	7.56E-04	1.98E-02	6.26E-02	1.06E-01	7.65E-02	4.75E-02	4.41E-02	4.28E-02	3.92E-02	3.61E-02	3.34E-02	2.74E-02
Cranium	1.40E-05*	5.39E-03	4.39E-02	1.37E-01	1.19E-01	4.79E-02	2.82E-02	2.37E-02	2.13E-02	1.97E-02	1.85E-02	1.52E-02
Eyes	0.00E+00	0.00E+00	4.00E-06†	2.33E-04	6.61E-04	6.87E-04	6.91E-04	6.71E-04	6.29E-04	5.85E-04	5.50E-04	4.81E-04
Lent. Nucl.	8.51E-01	5.99E-01	3.71E-01	1.50E-01	4.96E-02	2.82E-02	3.05E-02	3.21E-02	2.84E-02	2.40E-02	2.04E-02	1.13E-02
Mandible	0.00E+00	1.60E-05†	9.02E-04	1.15E-02	2.16E-02	1.28E-02	8.09E-03	6.82E-03	6.31E-03	5.83E-03	5.31E-03	4.56E-03
Other Tissues	0.00E+00	1.19E-04	4.72E-03	3.44E-02	5.15E-02	4.20E-02	4.01E-02	3.98E-02	3.73E-02	3.45E-02	3.23E-02	2.66E-02
Skin	0.00E+00	0.00E+00	1.51E-04	2.86E-03	5.05E-03	4.77E-03	5.07E-03	5.45E-03	5.29E-03	4.80E-03	4.46E-03	3.67E-03
Spinal Col.	0.00E+00	0.00E+00	4.80E-09‡	4.39E-05	9.04E-05	9.23E-05	8.80E-05	8.60E-05	7.60E-05	5.86E-05	6.01E-05	5.17E-05
Spinal Skel.	0.00E+00	0.00E+00	8.40E-05	2.39E-03	6.79E-03	4.50E-03	2.65E-03	1.94E-03	1.65E-03	1.49E-03	1.42E-03	1.13E-03
Thalami	2.79E-02	5.96E-02	6.31E-02	3.86E-02	1.57E-02	8.77E-03	8.78E-03	8.95E-03	8.28E-03	7.55E-03	6.90E-03	5.00E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	4.42E-05	1.47E-04	1.90E-04	1.93E-04	1.76E-04	1.80E-04	1.76E-04	1.68E-04	1.44E-04
Trunk	0.00E+00	0.00E+00	1.00E-06‡	1.64E-04	2.07E-03	3.88E-03	4.84E-03	6.68E-03	8.51E-03	9.53E-03	1.03E-02	1.08E-02
White Matter	9.92E-02	2.65E-01	3.83E-01	3.50E-01	1.86E-01	1.07E-01	1.02E-01	1.00E-01	9.22E-02	8.38E-02	7.73E-02	6.06E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.85E-01
Caud. Nucl.	1.02E-05	1.92E-05	2.74E-05	7.35E-05	1.93E-04	5.72E-04	1.83E-03	7.00E-03	1.75E-02	2.82E-02	3.81E-02	5.58E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.06E-07‡	1.80E-06*	3.91E-06	1.23E-05	2.47E-05	3.83E-05	4.51E-05	8.58E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-06	1.60E-05	3.76E-05	1.17E-04	2.21E-04	5.05E-04	1.90E-03	2.34E-02
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.50E-06*	1.84E-05	4.32E-05	1.14E-04	1.95E-04	2.78E-04	3.19E-04	1.25E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9 66E-08‡	1.24E-06*	3.77E-06	4.96E-06	7.29E-06	1.09E-05
Lent. Nucl.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.96E-01	9.87E-01	9.49E-01	8.72E-01	7.91E-01	7.15E-01	4.71E-01
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.59E-06	1.22E-05	2.23E-05	4.31E-05	6.06E-05	7.75E-05	1.36E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-06†	9.11E-06	2.27E-05	7.79E-05	1.72E-04	2.73E-04	3.47E-04	6.68E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.75E-07‡	2.13E-06*	8.61E-06	2.21E-05	3.52E-05	4.15E-05	8.92E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.92E-08‡	3.90E-07*	2.63E-07*	3.48E-07*	7.53E-07*	1.31E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.67E-07‡	1.64E-06†	6.91E-06	1.38E-05	1.68E-05	2.36E-05	3.83E-05
Thalami	1.74E-05	3.17E-05	4.03E-05	8.67E-05	2.27E-04	7.46E-04	2.40E-03	9.58E-03	2.38E-02	3.78E-02	5.05E-02	8.09E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.15E-07‡	3.91E-07‡	1.22E-06*	9.85E-07*	1.14E-06	3.07E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.16E-07‡	2.63E-06*	6.40E-06	1.76E-05	3.20E-05	5.47E-05	1.29E-04
White Matter	4.65E-05	8.51E-05	1.63E-04	3.16E-04	7.89E-04	2.75E-03	8.32E-03	3.24E-02	8.33E-02	1.36E-01	1.85E-01	3.43E-01

Table A.79: Absorbed Fractions for the Adult Phantom for Sources Located in the Spinal CSF.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	8.39E-05	1.85E-03	1.24E-02	2.52E-02	2.46E-02	2.45E-02	2.47E-02	2.37E-02	2.19E-02	2.05E-02	1.73E-02
Caud. Nucl.	0.00E+00	0.00E+00	1.94E-06‡	3.91E-05	1.30E-04	1.58E-04	1.61E-04	1.59E-04	1.43E-04	1.41E-04	1.24E-04	1.03E-04
Cerebellum	0.00E+00	2.00E-06‡	1.40E-04	1.71E-03	3.58E-03	3.39E-03	3.44E-03	3.39E-03	3.32E-03	3.06E-03	2.86E-03	2.43E-03
Cereb. Cort.	0.00E+00	7.09E-05	1.15E-03	5.54E-03	9.91E-03	9.65E-03	9.74E-03	9.94E-03	9.67E-03	8.94E-03	8.30E-03	7.12E-03
Cranium	4.22E-03	1.10E-02	1.68E-02	2.51E-02	3.01E-02	1.64E-02	1.09E-02	9.40E-03	8.82E-03	8.18E-03	7.63E-03	6.36E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	2.80E-06†	3.60E-05	8.52E-05	1.08E-04	1.15E-04	1.07E-04	1.08E-04	1.34E-04	9.02E-05
Lent. Nucl.	0.00E+00	0.00E+00	4.94E-06†	1.64E-04	4.27E-04	4.31E-04	4.06E-04	3.97E-04	3.78E-04	3.35E-04	2.99E-04	2.52E-04
Mandible	0.00E+00	0.00E+00	3.68E-05	3.56E-03	1.33E-02	9.35E-03	5.97E-03	5.03E-03	4.59E-03	4.38E-03	4.14E-03	3.48E-03
Other Tissues	1.00E-06	1.36E-04	9.90E-03	1.02E-01	1.40E-01	1.10E-01	1.08E-01	1.09E-01	1.01E-01	9.40E-02	8.78E-02	7.18E-02
Skin	0.00E+00	1.00E-06	1.55E-04	2.59E-03	4.62E-03	4.40E-03	4.76E-03	5.21E-03	4.93E-03	4.55E-03	4.36E-03	3.55E-03
Spinal Col.	9.25E-02	1.17E-01	8.18E-02	3.42E-02	1.17E-02	6.99E-03	7.51E-03	7.94E-03	7.39E-03	6.57E-03	5.83E-03	3.31E-03
Spinal Skel.	1.86E-01	4.39E-01	6.25E-01	6.14E-01	3.05E-01	1.01E-01	7.04E-02	6.69E-02	6.15E-02	5.61E-02	5.10E-02	3.85E-02
Thalami	0.00E+00	0.00E+00	1.79E-05*	2.23E-04	5.23E-04	4.66E-04	4.24E-04	4.36E-04	4.05E-04	3.56E-04	3.55E-04	3.02E-04
Thyroid	0.00E+00	0.00E+00	3.07E-05	7.86E-04	1.40E-03	1.10E-03	1.03E-03	1.01E-03	9.27E-04	8.48E-04	8.17E-04	6.51E-04
Trunk	4.10E-03	1.08E-02	1.86E-02	4.00E-02	6.91E-02	6.96E-02	6.89E-02	7.29E-02	7.29E-02	7.15E-02	6.94E-02	6.13E-02
White Matter	0.00E+00	1.10E-05	5.33E-04	4.54E-03	1.03E-02	1.01E-02	9.98E-03	1.00E-02	9.47E-03	8.78E-03	8.26E-03	6.87E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.61E-06†	1.22E-05	4.61E-05	1.01E-04	1.71E-04	2.22E-04	2.47E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E-07†	6.03E-07*	1.66E-06	1.50E-06	2.52E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.02E-07‡	2.54E-06*	6.53E-06	1.52E-05	2.40E-05	3.20E-05	7.17E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-06†	4.66E-06	1.98E-05	4.13E-05	6.76E-05	9.03E-05	2.19E-03
Cranium	1.55E-06‡	3.74E-06†	1.03E-05	1.54E-05	3.54E-05	1.38E-04	3.43E-04	1.45E-03	3.71E-03	6.12E-03	8.56E-03	1.40E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.70E-08‡	5.56E-07‡	2.29E-07*	4.73E-07*	3.56E-07	2.48E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.06E-08‡	6.15E-09‡	6.97E-07*	1.53E-06*	3.64E-06	3.75E-06	8.96E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-06‡	3.81E-06*	1.65E-05	3.22E-05	4.58E-05	6.09E-05	1.09E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-06	2.28E-05	5.10E-05	2.12E-04	4.74E-04	7.52E-04	1.01E-03	8.01E-03
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.53E-07‡	2.13E-06*	7.61E-06	2.14E-05	3.40E-05	4.76E-05	8.94E-05
Spinal Col.	3.91E-05	9.16E-05	1.67E-04	3.29E-04	8.38E-04	2.71E-03	8.62E-03	3.44E-02	8.81E-02	1.39E-01	1.62E-01	1.16E-01
Spinal Skel.	8.45E-05	1.61E-04	2.81E-04	6.04E-04	1.53E-03	4.87E-03	1.52E-02	6.02E-02	1.57E-01	2.57E-01	3.33E-01	5.22E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.49E-08‡	3.65E-08‡	6.26E-07	2.24E-06	3.19E-06	3.84E-06	9.24E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-08‡	5.19E-07†	2.08E-06*	5.13E-06	9.10E-06	7.44E-06	1.90E-05
Trunk	1.46E-06‡	3.66E-06†	7.36E-06*	9.27E-06	4.07E-05	1.22E-04	3.96E-04	1.49E-03	3.89E-03	6.51E-03	9.13E-03	1.85E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-06*	4.72E-06	1.76E-05	3.94E-05	6.87E-05	8.76E-05	1.76E-04

Table A.80: Absorbed Fractions for the Adult Phantom for Sources Located in the Spinal Skeleton.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	2.80E-05	8.79E-04	9.77E-03	2.34E-02	2.41E-02	2.39E-02	2.41E-02	2.31E-02	2.19E-02	2.04E-02	1.73E-02
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	3.07E-05	1.50E-04	1.54E-04	1.61E-04	1.56E-04	1.39E-04	1.24E-04	1.28E-04	1.15E-04
Cerebellum	0.00E+00	1.02E-06‡	9.78E-05	1.39E-03	3.45E-03	3.37E-03	3.40E-03	3.48E-03	3.31E-03	3.07E-03	2.86E-03	2.44E-03
Cereb. Cort.	0.00E+00	2.70E-05	5.37E-04	4.35E-03	9.08E-03	9.38E-03	9.50E-03	9.67E-03	9.29E-03	8.89E-03	8.31E-03	7.04E-03
Cranium	1.14E-03	4.07E-03	9.03E-03	2.14E-02	2.88E-02	1.61E-02	1.07E-02	9.35E-03	8.73E-03	8.16E-03	7.73E-03	6.37E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	2.99E-06†	3.92E-05	8.30E-05	1.04E-04	1.24E-04	1.25E-04	1.22E-04	1.12E-04	9.48E-05
Lent. Nucl.	0.00E+00	0.00E+00	4.99E-06*	1.21E-04	4.43E-04	4.14E-04	3.93E-04	3.93E-04	3.53E-04	3.42E-04	3.27E-04	2.58E-04
Mandible	0.00E+00	2.00E-06‡	2.16E-04	4.59E-03	1.38E-02	9.42E-03	6.03E-03	5.20E-03	4.75E-03	4.38E-03	4.14E-03	3.47E-03
Other Tissues	1.40E-02	4.31E-02	8.59E-02	1.56E-01	1.55E-01	1.17E-01	1.16E-01	1.18E-01	1.10E-01	1.02E-01	9.44E-02	7.61E-02
Skin	0.00E+00	9.71E-05	8.73E-04	3.64E-03	4.92E-03	4.47E-03	4.80E-03	5.34E-03	4.98E-03	4.75E-03	4.48E-03	3.55E-03
Spinal Col.	3.92E-04	3.46E-03	6.31E-03	6.78E-03	3.89E-03	2.62E-03	2.72E-03	2.79E-03	2.59E-03	2.40E-03	2.23E-03	1.70E-03
Spinal Skel.	9.77E-01	9.29E-01	8.54E-01	6.43E-01	3.08E-01	1.04E-01	7.55E-02	7.33E-02	6.61E-02	5.85E-02	5.20E-02	3.59E-02
Thalami	0.00E+00	0.00E+00	2.96E-06†	1.88E-04	4.50E-04	4.43E-04	4.43E-04	4.09E-04	3.92E-04	3.57E-04	3.34E-04	2.71E-04
Thyroid	0.00E+00	1.00E-06‡	1.40E-04	9.24E-04	1.41E-03	1.09E-03	1.02E-03	1.02E-03	9.08E-04	8.65E-04	8.00E-04	6.53E-04
Trunk	1.07E-03	4.03E-03	1.03E-02	3.40E-02	6.49E-02	6.67E-02	6.61E-02	7.03E-02	7.09E-02	6.91E-02	6.71E-02	5.95E-02
White Matter	0.00E+00	0.00E+00	2.34E-04	3.58E-03	9.53E-03	9.98E-03	9.68E-03	9.68E-03	9.33E-03	8.82E-03	8.22E-03	6.95E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.93E-06†	1.19E-05	5.50E-05	1.25E-04	1.87E-04	2.50E-04	2.20E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-07‡	2.22E-07†	1.23E-06*	1.17E-06	2.08E-06	3.40E-06
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-06†	1.15E-06*	7.96E-06	1.77E-05	2.66E-05	3.82E-05	2.00E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.10E-06‡	5.43E-06	2.27E-05	5.06E-05	7.40E-05	9.97E-05	1.77E-03
Cranium	7.34E-07‡	2.33E-06‡	4.58E-06*	1.51E-05	3.13E-05	8.96E-05	2.95E-04	1.11E-03	2.83E-03	4.92E-03	6.91E-03	1.25E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.31E-07*	2.04E-07*	3.58E-07	1.41E-06	1.56E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-08‡	7.79E-07*	1.85E-06	3.95E-06	4.13E-06	6.95E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.58E-07‡	1.93E-06†	7.75E-06	1.67E-05	3.50E-05	5.31E-05	7.27E-05	1.13E-04
Other Tissues	2.23E-05	3.47E-05	7.98E-05	1.58E-04	3.35E-04	1.17E-03	3.76E-03	1.43E-02	3.67E-02	6.17E-02	8.73E-02	1.85E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.89E-07†	3.15E-06	1.12E-05	2.71E-05	3.82E-05	5.16E-05	9.84E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-06‡	1.22E-06*	2.19E-06	8.46E-06	1.74E-05	7.43E-04	3.87E-03	1.98E-02
Spinal Skel.	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.98E-01	9.93E-01	9.74E-01	9.33E-01	8.88E-01	8.42E-01	6.73E-01
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4 62E-07†	7.49E-07	2.39E-06	3.42E-06	4.50E-06	8.81E-06
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.29E-08‡	4.36E-07†	3.17E-06	6.53E-06	8.54E-06	1.12E-05	1.97E-05
Trunk	1.55E-06‡	3.91E-06*	1.15E-06‡	1.12E-05*	3.51E-05	8.32E-05	2.82E-04	1.12E-03	3.09E-03	5.23E-03	7.45E-03	1.64E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-06†	4.53E-06	2.21E-05	4.92E-05	7.58E-05	9.90E-05	2.02E-04

Table A.81: Absorbed Fractions for the Adult Phantom for Sources Located in the Thalami.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.98E-01	9.62E-01	7.33E-01	3.79E-01	2.20E-01	2.11E-01	2.11E-01	1.93E-01	1.74E-01	1.58E-01	1.20E-01
Caud. Nucl.	2.90E-03	1.28E-02	1.79E-02	1.40E-02	6.26E-03	3.55E-03	3.43E-03	3.49E-03	3.21E-03	2.92E-03	2.74E-03	2.06E-03
Cerebellum	0.00E+00	9.67E-05	3.50E-03	1.48E-02	1.41E-02	8.96E-03	8.09E-03	7.78E-03	7.04E-03	6.61E-03	6.10E-03	4.99E-03
Cereb. Cort.	2.90E-05	7.77E-03	4.70E-02	1.02E-01	7.86E-02	4.85E-02	4.45E-02	4.33E-02	3.96E-02	3.65E-02	3.36E-02	2.72E-02
Cranium	0.00E+00	1.75E-03	2.86E-02	1.20E-01	1.16E-01	4.75E-02	2.75E-02	2.27E-02	2.05E-02	1.89E-02	1.77E-02	1.45E-02
Eyes	0.00E+00	0.00E+00	1.00E-06‡	1.06E-04	4.08E-04	4.52E-04	4.84E-04	4.84E-04	4.44E-04	4.12E-04	3.89E-04	3.05E-04
Lent. Nucl.	3.40E-02	7.25E-02	7.69E-02	4.75E-02	1.93E-02	1.07E-02	1.07E-02	1.09E-02	1.01E-02	8.97E-03	8.47E-03	6.09E-03
Mandible	0.00E+00	9.89E-07‡	3.87E-04	8.36E-03	1.89E-02	1.16E-02	7.17E-03	5.94E-03	5.38E-03	5.08E-03	4.73E-03	4.00E-03
Other Tissues	0.00E+00	5.64E-05	3.90E-03	3.68E-02	5.58E-02	4.51E-02	4.26E-02	4.22E-02	3.95E-02	3.63E-02	3.42E-02	2.82E-02
Skin	0.00E+00	0.00E+00	8.34E-05	2.57E-03	5.11E-03	4.74E-03	4.95E-03	5.33E-03	5.07E-03	4.70E-03	4.42E-03	3.58E-03
Spinal Col.	0.00E+00	0.00E+00	4.97E-06*	1.02E-04	1.54E-04	1.41E-04	1.40E-04	1.34E-04	1.19E-04	1.24E-04	1.15E-04	8.54E-05
Spinal Skel.	0.00E+00	2.00E-06‡	2.46E-04	5.07E-03	1.10E-02	6.55E-03	3.80E-03	3.05E-03	2.75E-03	2.40E-03	2.34E-03	1.84E-03
Thalami	8.65E-01	6.17E-01	3.88E-01	1.58E-01	5.22E-02	2.96E-02	3.21E-02	3.38E-02	3.01E-02	2.53E-02	2.15E-02	1.21E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	4.54E-05	1.76E-04	1.82E-04	1.74E-04	2.18E-04	1.76E-04	1.72E-04	1.67E-04	1.37E-04
Trunk	0.00E+00	0.00E+00	0.00E+00	2.07E-04	2.21E-03	4.42E-03	5.32E-03	7.26E-03	9.28E-03	1.04E-02	1.09E-02	1.19E-02
White Matter	9.22E-02	2.58E-01	3.86E-01	3.62E-01	1.93E-01	1.10E-01	1.04E-01	1.03E-01	9.50E-02	8.66E-02	7.95E-02	6.26E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.18E-08‡	2.94E-06	4.78E-06	1.38E-04	1.30E-03	3.84E-03	7.04E-03	1.95E-02
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.93E-07‡	3.22E-06	6.95E-06	1.77E-05	4.03E-05	5.44E-05	7.07E-05	1.30E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	1.28E-06‡	5.29E-06*	1.51E-05	3.75E-05	1.13E-04	2.23E-04	3.30E-04	4.28E-04	3.12E-03
Cranium	0.00E+00	0.00E+00	0.00E+00	6.28E-07‡	3.34E-06*	1.47E-05	5.01E-05	1.11E-04	1.92E-04	2.58E-04	3.20E-04	5.06E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-07‡	5.61E-07†	1.83E-06	2.80E-06	2.87E-06	7.82E-06
Lent. Nucl.	1.41E-05*	3.49E-05	7.26E-05	1.11E-04	2.70E-04	9.75E-04	2.98E-03	1.17E-02	2.89E-02	4.68E-02	6.20E-02	9.84E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.06E-06	7.05E-06	2.10E-05	3.81E-05	5.16E-05	7.23E-05	1.14E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.18E-06	2.24E-05	8.50E-05	1.88E-04	2.86E-04	3.60E-04	7.17E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.84E-07†	1.76E-06*	9.22E-06	2.32E-05	3.21E-05	4.72E-05	8.19E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-07‡	1.86E-07†	5.09E-07*	5.87E-07	1.43E-06*	1.96E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.66E-07‡	2.19E-06*	3.93E-06	1.14E-05	2.37E-05	2.91E-05	3.83E-05	5.83E-05
Thalami	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.96E-01	9.89E-01	9.56E-01	8.88E-01	8.12E-01	7.37E-01	4.86E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.17E-07†	6.07E-07*	1.44E-06	1.39E-06*	2.96E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.57E-07‡	9.96E-07*	7.81E-06	2.36E-05	3.80E-05	5.71E-05	1.37E-04
White Matter	3.83E-05	7.11E-05	1.29E-04	2.69E-04	7.52E-04	2.46E-03	7.61E-03	3.03E-02	7.69E-02	1.24E-01	1.71E-01	3.36E-01

Table A.82: Absorbed Fractions for the Adult Phantom for Sources Located in the Third Ventricle.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.99E-01	9.73E-01	7.56E-01	3.93E-01	2.27E-01	2.18E-01	2.17E-01	1.98E-01	1.79E-01	1.63E-01	1.24E-01
Caud. Nucl.	1.10E-05*	2.67E-03	9.72E-03	1.10E-02	5.68E-03	3.08E-03	2.92E-03	2.81E-03	2.60E-03	2.45E-03	2.16E-03	1.77E-03
Cerebellum	0.00E+00	1.25E-04	3.81E-03	1.60E-02	1.46E-02	9.29E-03	8.31E-03	8.02E-03	7.35E-03	6.80E-03	6.28E-03	5.07E-03
Cereb. Cort.	1.00E-06‡	4.49E-03	3.96E-02	1.00E-01	8.01E-02	4.90E-02	4.47E-02	4.32E-02	3.95E-02	3.61E-02	3.38E-02	2.74E-02
Cranium	0.00E+00	8.28E-04	2.01E-02	1.09E-01	1.12E-01	4.66E-02	2.69E-02	2.21E-02	1.97E-02	1.87E-02	1.72E-02	1.43E-02
Eyes	0.00E+00	0.00E+00	0.00E+00	1.12E-04	4.08E-04	4.54E-04	4.73E-04	4.68E-04	4.62E-04	4.28E-04	3.85E-04	3.02E-04
Lent. Nucl.	1.80E-04	1.25E-02	3.23E-02	3.04E-02	1.41E-02	7.72E-03	7.43E-03	7.44E-03	6.75E-03	6.13E-03	5.73E-03	4.62E-03
Mandible	0.00E+00	1.00E-06‡	2.13E-04	6.69E-03	1.66E-02	1.06E-02	6.70E-03	5.41E-03	4.98E-03	4.66E-03	4.34E-03	3.53E-03
Other Tissues	0.00E+00	1.66E-05	2.69E-03	3.08E-02	5.05E-02	4.15E-02	3.90E-02	3.86E-02	3.61E-02	3.35E-02	3.12E-02	2.58E-02
Skin	0.00E+00	0.00E+00	1.02E-04	2.56E-03	5.04E-03	4.70E-03	4.98E-03	5.34E-03	5.08E-03	4.70E-03	4.42E-03	3.59E-03
Spinal Col.	0.00E+00	0.00E+00	1.20E-05*	7.96E-05	1.59E-04	1.51E-04	1.35E-04	1.52E-04	1.36E-04	1.13E-04	1.14E-04	8.76E-05
Spinal Skel.	0.00E+00	2.00E-06‡	1.89E-04	4.62E-03	1.03E-02	6.33E-03	3.72E-03	2.92E-03	2.65E-03	2.44E-03	2.27E-03	1.91E-03
Thalami	4.22E-02	1.65E-01	1.71E-01	9.22E-02	3.34E-02	1.86E-02	1.92E-02	2.00E-02	1.85E-02	1.69E-02	1.55E-02	1.09E-02
Thyroid	0.00E+00	0.00E+00	0.00E+00	3.62E-05	1.71E-04	1.68E-04	1.70E-04	1.67E-04	1.68E-04	1.64E-04	1.59E-04	1.43E-04
Trunk	0.00E+00	0.00E+00	5.93E-08‡	1.76E-04	1.90E-03	3.99E-03	4.95E-03	7.02E-03	9.04E-03	1.01E-02	1.06E-02	1.15E-02
White Matter	3.46E-01	4.84E-01	5.14E-01	4.16E-01	2.12E-01	1.21E-01	1.16E-01	1.16E-01	1.06E-01	9.64E-02	8.76E-02	6.63E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.86E-01
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.30E-07‡	1.02E-06*	2.95E-06*	8.99E-06	1.49E-05	2.37E-05	3.02E-05	1.93E-04
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.47E-07‡	3.05E-06*	4.78E-06	2.15E-05	3.98E-05	6.53E-05	7.39E-05	1.43E-04
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.19E-06*	1.47E-05	3.50E-05	1.10E-04	2.21E-04	3.31E-04	4.16E-04	9.01E-04
Cranium	0.00E+00	0.00E+00	0.00E+00	7.39E-07‡	3.53E-06†	1.67E-05	4.42E-05	1.06E-04	1.80E-04	2.47E-04	2.96E-04	4.76E-04
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-07‡	4.45E-07†	8.32E-07*	1.81E-06*	3.01E-06	4.09E-06	7.78E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.75E-06*	3.57E-06*	9.99E-06	2.69E-05	4.38E-05	6.49E-05	9.18E-05	1.19E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E-06†	4.70E-06	1.80E-05	3.50E-05	4.71E-05	5.91E-05	1.12E-04
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.36E-07‡	5.12E-06	2.08E-05	7.39E-05	1.72E-04	2.67E-04	3.50E-04	6.41E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-07‡	2.81E-06	7.67E-06	2.31E-05	3.25E-05	4.52E-05	8.42E-05
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-08‡	3.21E-07*	6.51E-07‡	1.29E-06*	9.58E-07*	1.88E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.43E-07‡	2.12E-07‡	2.09E-06*	1.05E-05	2.30E-05	3.09E-05	3.50E-05	5.74E-05
Thalami	0.00E+00	4.88E-07‡	0.00E+00	2.98E-06*	1.29E-05	1.74E-05	3.21E-05	8.51E-05	9.58E-03	5.70E-02	1.26E-01	2.67E-01
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.78E-07‡	2.62E-07†	1.19E-06*	1.94E-06	1.26E-06*	4.11E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.29E-07†	7.18E-06	2.25E-05	3.69E-05	4.98E-05	1.36E-04
White Matter	2.14E-04	4.43E-04	7.37E-04	1.58E-03	3.82E-03	1.27E-02	3.87E-02	1.53E-01	3.67E-01	4.92E-01	5.23E-01	5.00E-01

Table A.83: Absorbed Fractions for the Adult Phantom for Sources Located in the Thyroid.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	1.40E-05†	1.37E-03	6.16E-03	7.64E-03	8.02E-03	8.96E-03	9.18E-03	8.81E-03	8.53E-03	7.55E-03
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	1.01E-05	5.07E-05	7.24E-05	8.19E-05	8.71E-05	8.08E-05	7.59E-05	7.04E-05	6.63E-05
Cerebellum	0.00E+00	0.00E+00	0.00E+00	4.68E-05	4.48E-04	6.12E-04	6.63E-04	7.65E-04	7.90E-04	7.50E-04	7.50E-04	6.72E-04
Cereb. Cort.	0.00E+00	0.00E+00	5.98E-06*	5.54E-04	2.33E-03	2.94E-03	3.11E-03	3.58E-03	3.70E-03	3.49E-03	3.40E-03	3.04E-03
Cranium	0.00E+00	0.00E+00	4.94E-05	2.04E-03	6.10E-03	4.76E-03	3.23E-03	2.88E-03	2.94E-03	2.84E-03	2.74E-03	2.36E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	2.12E-06†	4.23E-05	7.75E-05	1.03E-04	1.28E-04	1.24E-04	1.22E-04	1.27E-04	9.40E-05
Lent. Nucl.	0.00E+00	0.00E+00	9.76E-07‡	3.99E-05	1.61E-04	1.75E-04	1.88E-04	1.92E-04	1.79E-04	1.71E-04	1.69E-04	1.48E-04
Mandible	0.00E+00	8.66E-05	2.39E-03	1.68E-02	2.31E-02	1.15E-02	6.93E-03	5.90E-03	5.37E-03	4.94E-03	4.71E-03	3.82E-03
Other Tissues	1.47E-01	3.66E-01	4.82E-01	4.09E-01	2.15E-01	1.30E-01	1.27E-01	1.30E-01	1.21E-01	1.11E-01	1.03E-01	8.12E-02
Skin	6.00E-06	1.84E-03	7.48E-03	1.00E-02	6.53E-03	4.54E-03	4.63E-03	5.07E-03	4.76E-03	4.46E-03	4.17E-03	3.38E-03
Spinal Col.	0.00E+00	0.00E+00	9.02E-06*	2.47E-04	4.59E-04	3.43E-04	3.39E-04	3.34E-04	3.00E-04	2.72E-04	2.72E-04	2.10E-04
Spinal Skel.	0.00E+00	1.32E-04	3.95E-03	2.51E-02	3.13E-02	1.46E-02	8.86E-03	7.38E-03	6.85E-03	6.18E-03	5.74E-03	4.69E-03
Thalami	0.00E+00	0.00E+00	0.00E+00	5.53E-05	1.56E-04	1.61E-04	1.69E-04	1.54E-04	1.49E-04	1.37E-04	1.46E-04	1.19E-04
Thyroid	8.48E-01	5.99E-01	3.78E-01	1.56E-01	5.18E-02	2.97E-02	3.21E-02	3.36E-02	2.99E-02	2.53E-02	2.15E-02	1.25E-02
Trunk	4.72E-03	2.73E-02	7.45E-02	1.55E-01	1.68E-01	1.31E-01	1.24E-01	1.27E-01	1.24E-01	1.19E-01	1.14E-01	9.82E-02
White Matter	0.00E+00	0.00E+00	7.02E-06*	6.35E-04	2.89E-03	3.54E-03	3.68E-03	4.05E-03	4.14E-03	4.04E-03	3.86E-03	3.39E-03

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.93E-07‡	9.16E-07‡	2.72E-06*	1.51E-05	3.28E-05	5.02E-05	7.15E-05	1.54E-04
Caud. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-08‡	7.58E-08†	1.57E-07†	3.12E-07†	5.83E-07*	8.96E-07*
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-06†	1.34E-06*	2.68E-06	3.64E-06	6.77E-06	1.50E-05
Cereb. Cort.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-08‡	1.23E-06*	5.19E-06	1.10E-05	2.08E-05	2.75E-05	5.98E-05
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.06E-07‡	1.92E-06*	7.83E-06	1.62E-05	2.38E-05	3.08E-05	5.51E-05
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-08‡	2.25E-07‡	2.31E-07†	8.12E-07	5.94E-07†	1.44E-06
Lent. Nucl.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.83E-08‡	1.06E-08‡	1.41E-07‡	1.10E-06*	7.81E-07	1.42E-06	3.85E-06
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.72E-07‡	3.61E-06*	6.45E-06	2.35E-05	4.25E-05	5.75E-05	6.87E-05	1.24E-04
Other Tissues	7.60E-05	1.20E-04	2.52E-04‡	5.19E-04‡	1.22E-03*	4.10E-03	1.27E-02	4.93E-02	1.24E-01	2.00E-01	2.72E-01	4.86E-01
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.74E-07	4.80E-07‡	2.59E-06†	1.16E-05	2.37E-05	3.49E-05	4.96E-05	4.74E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.85E-09‡	3.30E-07‡	4.64E-07*	2.19E-06	1.73E-06	2.75E-06	4.90E-06
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-06‡	2.77E-06*	1.03E-05	2.90E-05	5.46E-05	7.89E-05	9.13E-05	1.51E-04
Thalami	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.43E-08‡	2.33E-07‡	1.02E-08‡	8.53E-07*	7.56E-07*	6.56E-07	1.38E-06*	3.53E-06
Thyroid	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.96E-01	9.87E-01	9.49E-01	8.70E-01	7.88E-01	7.09E-01	4.64E-01
Trunk	0.00E+00	0.00E+00	2.91E-07‡	0.00E+00	9.71E-06	3.95E-05	1.57E-04	9.05E-04	3.29E-03	6.93E-03	1.13E-02	3.53E-02
White Matter	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.44E-08‡	5.75E-07‡	4.59E-07†	7.26E-06	1.65E-05	2.35E-05	3.21E-05	6.78E-05

Table A.84: Absorbed Fractions for the Adult Phantom for Sources Located in the White Matter.

	Photon Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	9.83E-01	9.05E-01	6.40E-01	3.18E-01	1.86E-01	1.83E-01	1.83E-01	1.68E-01	1.52E-01	1.39E-01	1.04E-01
Caud. Nucl.	2.38E-03	5.90E-03	7.92E-03	6.83E-03	3.43E-03	1.97E-03	1.90E-03	1.88E-03	1.72E-03	1.63E-03	1.43E-03	1.09E-03
Cerebellum	1.30E-05	1.79E-03	8.15E-03	1.58E-02	1.23E-02	7.65E-03	7.10E-03	7.06E-03	6.32E-03	5.93E-03	5.53E-03	4.51E-03
Cereb. Cort.	4.45E-02	1.21E-01	1.73E-01	1.65E-01	9.38E-02	5.61E-02	5.45E-02	5.45E-02	5.02E-02	4.64E-02	4.27E-02	3.37E-02
Cranium	1.06E-04	1.43E-02	7.39E-02	1.67E-01	1.23E-01	4.71E-02	2.90E-02	2.53E-02	2.32E-02	2.14E-02	2.02E-02	1.66E-02
Eyes	0.00E+00	0.00E+00	9.92E-06*	2.63E-04	5.02E-04	5.10E-04	5.26E-04	5.54E-04	4.95E-04	4.78E-04	4.52E-04	3.70E-04
Lent. Nucl.	2.95E-03	8.05E-03	1.14E-02	1.06E-02	5.51E-03	3.13E-03	2.99E-03	2.99E-03	2.70E-03	2.54E-03	2.27E-03	1.78E-03
Mandible	0.00E+00	8.02E-06	3.58E-04	4.50E-03	1.06E-02	7.16E-03	4.62E-03	3.95E-03	3.77E-03	3.48E-03	3.28E-03	2.80E-03
Other Tissues	0.00E+00	7.95E-05	2.44E-03	1.95E-02	3.10E-02	2.69E-02	2.62E-02	2.69E-02	2.55E-02	2.39E-02	2.23E-02	1.83E-02
Skin	0.00E+00	3.29E-05	1.08E-03	5.70E-03	6.83E-03	5.50E-03	5.83E-03	6.32E-03	6.09E-03	5.52E-03	5.11E-03	4.19E-03
Spinal Col.	0.00E+00	0.00E+00	6.06E-06*	4.19E-05	7.58E-05	9.11E-05	8.26E-05	8.14E-05	7.72E-05	6.92E-05	7.61E-05	5.15E-05
Spinal Skel.	0.00E+00	5.00E-06†	1.60E-04	2.43E-03	5.58E-03	3.49E-03	2.27E-03	1.81E-03	1.61E-03	1.52E-03	1.41E-03	1.14E-03
Thalami	2.35E-03	6.26E-03	9.25E-03	8.64E-03	4.63E-03	2.66E-03	2.52E-03	2.53E-03	2.30E-03	2.02E-03	1.95E-03	1.55E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	1.67E-05*	8.77E-05	1.05E-04	1.10E-04	1.19E-04	1.20E-04	1.05E-04	1.12E-04	1.08E-04
Trunk	0.00E+00	0.00E+00	0.00E+00	7.64E-05	1.05E-03	2.47E-03	3.21E-03	4.67E-03	6.33E-03	6.98E-03	7.32E-03	8.10E-03
White Matter	9.43E-01	8.29E-01	6.80E-01	4.20E-01	1.91E-01	1.11E-01	1.10E-01	1.11E-01	1.01E-01	9.02E-02	8.20E-02	5.94E-02

	Electron Absorbed Fraction of Energy: ϕ											
	Energy (MeV)											
Targets	0.010	0.015	0.020	0.030	0.050	0.100	0.200	0.500	1.000	1.500	2.000	4.000
Brain (Total)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.97E-01	9.95E-01	9.93E-01	9.75E-01
Caud. Nucl.	1.93E-06‡	4.98E-06	3.31E-06†	3.24E-06†	1.96E-05	6.66E-05	2.04E-04	8.21E-04	2.01E-03	3.24E-03	4.36E-03	7.72E-03
Cerebellum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E-07‡	2.71E-06†	5.09E-06	1.61E-05	3.56E-05	5.40E-05	6.87E-05	1.20E-03
Cereb. Cort.	2.40E-05	3.82E-05	5.52E-05	1.37E-04	3.46E-04	1.09E-03	3.54E-03	1.40E-02	3.60E-02	5.99E-02	8.38E-02	1.61E-01
Cranium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E-06†	2.43E-05	5.41E-05	1.25E-04	2.20E-04	2.93E-04	3.70E-04	7.97E-03
Eyes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.91E-08‡	7.75E-07	1.17E-06	3.75E-06	4.30E-06	8.46E-06
Lent. Nucl.	1.60E-06‡	2.19E-06†	7.61E-06*	9.10E-06*	1.76E-05	9.06E-05	2.58E-04	9.78E-04	2.51E-03	4.08E-03	5.58E-03	1.02E-02
Mandible	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E-06†	3.06E-06*	1.17E-05	2.22E-05	3.12E-05	4.15E-05	7.67E-05
Other Tissues	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.56E-07‡	2.47E-06*	1.17E-05	4.47E-05	1.09E-04	1.73E-04	2.26E-04	4.93E-04
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.92E-07†	2.87E-06	1.15E-05	2.66E-05	4.05E-05	5.44E-05	1.04E-04
Spinal Col.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.57E-08†	2.09E-07*	1.08E-06*	9.83E-07*	1.52E-06*
Spinal Skel.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.63E-07‡	3.15E-07‡	1.74E-06*	5.51E-06	1.20E-05	1.46E-05	1.87E-05	3.59E-05
Thalami	0.00E+00	8.96E-07‡	2.63E-06†	1.05E-05*	1.63E-05	6.28E-05	1.92E-04	7.10E-04	1.83E-03	3.08E-03	4.31E-03	8.14E-03
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.20E-08‡	0.00E+00	2.83E-07‡	4.18E-07*	4.60E-07*	9.17E-07*	2.45E-06
Trunk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.25E-07‡	8.90E-07†	5.36E-06	1.31E-05	2.10E-05	3.76E-05	9.33E-05
White Matter	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.80E-01	9.50E-01	9.17E-01	8.86E-01	7.72E-01

APPENDIX B
RADIONUCLIDE S VALUES FOR THE NEW HEAD AND BRAIN PEDIATRIC MODELS

This appendix gives tables of radionuclide S values for the full series of head and brain models. S values are given for 14 source regions, and 16 target regions. Tables B.1 through B.14 are for a newborn phantom, Tables B.15 through B.28 are for 1-year-old phantom, Tables B.29 through B.42 are for 5-year-old phantom, Tables B.43 through B.56 are for 10-year-old phantom, Tables B.57 through B.70 are for 15-year-old phantom, and Tables B.71 through B.84 are for an adult phantom. These S values are given for 24 radionuclides for source within the brain, and for 12 radionuclide for bone sources and the thyroid as a source.

S Values in a Mathematical Model of the Head and Brain of a Newborn

Table B.1: S values for the Newborn Phantom for Sources Located in the Brain (total).

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.08E-04	2.51E-04	3.50E-04	1.52E-04	2.89E-04	1.35E-03	5.64E-04	6.08E-05	7.19E-05	3.59E-04	6.11E-04	1.08E-04
Caud. Nucl.	2.23E-04	2.67E-04	3.69E-04	1.65E-04	2.98E-04	1.58E-03	6.03E-04	6.36E-05	7.38E-05	3.96E-04	6.57E-04	1.10E-04
Cerebellum	2.00E-04	2.42E-04	3.36E-04	1.45E-04	2.83E-04	1.22E-03	5.37E-04	5.95E-05	7.12E-05	3.33E-04	5.78E-04	1.07E-04
Cereb. Cort.	2.01E-04	2.42E-04	3.35E-04	1.46E-04	2.81E-04	1.16E-03	5.27E-04	5.95E-05	7.11E-05	3.30E-04	5.65E-04	1.07E-04
Cranium	4.02E-05	5.12E-05	8.46E-05	3.08E-05	5.32E-05	5.71E-04	1.77E-04	6.64E-06	4.39E-06	1.34E-04	2.01E-04	4.90E-06
Eyes	1.46E-05	1.46E-05	1.46E-05	1.46E-05	4.56E-08	4.67E-05	1.51E-05	2.70E-06	1.54E-06	3.34E-05	1.70E-05	3.87E-08
Lent. Nucl.	2.18E-04	2.62E-04	3.64E-04	1.61E-04	2.96E-04	1.54E-03	6.00E-04	6.26E-05	7.33E-05	3.90E-04	6.54E-04	1.09E-04
Mandible	8.74E-06	8.78E-06	8.96E-06	8.74E-06	2.13E-07	3.17E-05	1.03E-05	1.62E-06	1.16E-06	2.14E-05	1.17E-05	2.74E-08
Other Tissues	9.56E-06	9.65E-06	1.02E-05	9.54E-06	5.82E-07	5.91E-05	1.40E-05	1.76E-06	1.03E-06	2.46E-05	1.64E-05	2.99E-08
Skin	1.49E-05	1.58E-05	2.07E-05	1.44E-05	5.68E-06	1.88E-04	4.39E-05	2.66E-06	1.49E-06	4.67E-05	5.21E-05	1.02E-07
Spinal Col.	7.65E-06	7.69E-06	8.07E-06	7.64E-06	3.99E-07	4.40E-05	1.12E-05	1.41E-06	8.64E-07	1.93E-05	1.32E-05	2.86E-08
Spinal Skel.	7.65E-06	7.70E-06	7.99E-06	7.64E-06	3.28E-07	4.14E-05	1.03E-05	1.41E-06	1.06E-06	1.90E-05	1.20E-05	2.48E-08
Thalami	2.19E-04	2.64E-04	3.68E-04	1.62E-04	2.97E-04	1.58E-03	6.07E-04	6.28E-05	7.35E-05	3.98E-04	6.62E-04	1.08E-04
Thyroid	3.72E-06	3.72E-06	3.73E-06	3.72E-06	6.92E-09	4.11E-06	3.68E-06	6.92E-07	4.55E-07	9.91E-06	4.02E-06	8.64E-09
Trunk	2.04E-07	2.04E-07	2.04E-07	2.04E-07	4.47E-10	2.27E-07	2.03E-07	3.81E-08	1.69E-08	5.80E-07	2.22E-07	4.94E-10
White Matter	2.16E-04	2.61E-04	3.65E-04	1.58E-04	2.99E-04	1.52E-03	6.01E-04	6.22E-05	7.30E-05	3.86E-04	6.54E-04	1.09E-04

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.23E-05	4.67E-04	2.29E-05	1.27E-04	1.65E-05	2.17E-04	9.90E-05	3.01E-04	6.19E-05	3.30E-05	2.43E-05	5.24E-05
Caud. Nucl.	1.37E-05	5.01E-04	2.58E-05	1.39E-04	1.87E-05	2.40E-04	1.04E-04	3.27E-04	6.32E-05	3.41E-05	2.58E-05	5.51E-05
Cerebellum	1.14E-05	4.43E-04	2.13E-05	1.18E-04	1.53E-05	2.03E-04	9.65E-05	2.84E-04	6.13E-05	3.23E-05	2.34E-05	5.10E-05
Cereb. Cort.	1.15E-05	4.34E-04	2.14E-05	1.18E-04	1.53E-05	2.05E-04	9.65E-05	2.85E-04	6.13E-05	3.24E-05	2.35E-05	5.11E-05
Cranium	4.21E-06	1.51E-04	1.12E-05	4.66E-05	1.18E-05	6.37E-05	1.26E-05	8.69E-05	5.90E-06	5.27E-06	6.02E-06	6.77E-06
Eyes	1.65E-06	1.41E-05	2.44E-06	1.42E-05	7.92E-07	2.93E-05	5.35E-06	3.01E-05	7.60E-07	9.73E-07	1.29E-06	3.29E-06
Lent. Nucl.	1.34E-05	4.98E-04	2.50E-05	1.36E-04	1.79E-05	2.33E-04	1.03E-04	3.19E-04	6.31E-05	3.41E-05	2.54E-05	5.46E-05
Mandible	1.33E-06	9.57E-06	2.17E-06	9.04E-06	1.24E-06	1.79E-05	3.34E-06	1.87E-05	1.05E-06	1.33E-06	1.60E-06	2.18E-06
Other Tissues	1.12E-06	1.28E-05	1.79E-06	9.76E-06	8.10E-07	1.95E-05	3.52E-06	2.05E-05	6.29E-07	7.44E-07	9.61E-07	2.17E-06
Skin	1.61E-06	3.86E-05	2.76E-06	1.60E-05	1.45E-06	2.90E-05	5.28E-06	3.23E-05	9.49E-07	1.02E-06	1.33E-06	3.23E-06
Spinal Col.	9.38E-07	1.03E-05	1.45E-06	7.68E-06	5.98E-07	1.60E-05	2.86E-06	1.68E-05	4.98E-07	6.16E-07	7.98E-07	1.79E-06
Spinal Skel.	1.22E-06	9.54E-06	2.12E-06	7.96E-06	1.40E-06	1.55E-05	2.95E-06	1.61E-05	1.07E-06	1.29E-06	1.53E-06	1.95E-06
Thalami	1.36E-05	5.04E-04	2.57E-05	1.39E-04	1.86E-05	2.38E-04	1.03E-04	3.25E-04	6.32E-05	3.40E-05	2.56E-05	5.51E-05
Thyroid	4.66E-07	3.44E-06	6.63E-07	4.01E-06	1.59E-07	8.17E-06	1.46E-06	8.77E-06	1.83E-07	2.62E-07	3.53E-07	9.46E-07
Trunk	1.77E-08	1.89E-07	2.32E-08	2.27E-07	1.75E-09	4.50E-07	7.08E-08	4.91E-07	4.90E-09	8.64E-09	1.20E-08	3.98E-08
White Matter	1.30E-05	4.98E-04	2.43E-05	1.35E-04	1.75E-05	2.29E-04	1.02E-04	3.17E-04	6.27E-05	3.37E-05	2.50E-05	5.38E-05

Table B.2: S values for the Newborn Phantom for Sources Located in the Caudate Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.21E-04	2.65E-04	3.69E-04	1.63E-04	2.98E-04	1.59E-03	6.06E-04	6.30E-05	7.34E-05	3.98E-04	6.62E-04	1.09E-04
Caud. Nucl.	2.16E-02	2.60E-02	3.45E-02	1.51E-02	3.22E-02	4.43E-02	4.49E-02	7.18E-03	9.25E-03	2.33E-02	4.54E-02	1.42E-02
Cerebellum	1.26E-05	1.27E-05	1.27E-05	1.27E-05	3.88E-08	1.40E-05	1.26E-05	2.34E-06	1.44E-06	2.93E-05	1.36E-05	3.30E-08
Cereb. Cort.	2.74E-05	2.75E-05	2.76E-05	2.75E-05	1.05E-07	1.34E-04	2.97E-05	5.08E-06	3.06E-06	6.48E-05	3.44E-05	7.50E-08
Cranium	2.03E-05	2.04E-05	2.05E-05	2.04E-05	1.24E-07	5.89E-05	2.10E-05	3.77E-06	2.80E-06	4.74E-05	2.35E-05	6.66E-08
Eyes	2.51E-05	2.52E-05	2.52E-05	2.52E-05	7.87E-08	2.81E-05	2.50E-05	4.64E-06	2.67E-06	5.72E-05	2.70E-05	6.55E-08
Lent. Nucl.	4.66E-04	6.51E-04	1.24E-03	2.96E-04	9.69E-04	1.02E-02	3.14E-03	8.20E-05	5.68E-05	1.87E-03	3.60E-03	1.19E-04
Mandible	1.32E-05	1.32E-05	1.32E-05	1.32E-05	6.06E-08	1.51E-05	1.32E-05	2.44E-06	1.79E-06	3.03E-05	1.42E-05	3.83E-08
Other Tissues	1.11E-05	1.11E-05	1.11E-05	1.11E-05	3.53E-08	1.31E-05	1.10E-05	2.05E-06	1.23E-06	2.53E-05	1.19E-05	2.92E-08
Skin	1.14E-05	1.14E-05	1.15E-05	1.14E-05	3.29E-08	1.26E-05	1.14E-05	2.11E-06	1.22E-06	2.54E-05	1.22E-05	2.95E-08
Spinal Col.	4.59E-06	4.59E-06	4.61E-06	4.60E-06	1.67E-08	5.20E-06	4.56E-06	8.51E-07	6.20E-07	1.12E-05	4.95E-06	1.23E-08
Spinal Skel.	5.40E-06	5.41E-06	5.43E-06	5.41E-06	2.67E-08	6.01E-06	5.39E-06	9.98E-07	8.10E-07	1.21E-05	5.80E-06	1.63E-08
Thalami	1.49E-04	1.73E-04	2.90E-04	1.33E-04	1.45E-04	5.38E-03	9.23E-04	2.54E-05	1.50E-05	7.14E-04	1.14E-03	4.61E-06
Thyroid	5.34E-06	5.34E-06	5.35E-06	5.34E-06	2.02E-08	5.71E-06	5.31E-06	9.93E-07	5.99E-07	1.32E-05	5.74E-06	1.76E-08
Trunk	2.16E-07	2.17E-07	2.17E-07	2.17E-07	5.42E-10	2.39E-07	2.15E-07	4.03E-08	1.85E-08	5.86E-07	2.34E-07	5.29E-10
White Matter	9.81E-05	1.20E-04	1.95E-04	7.82E-05	1.18E-04	2.05E-03	4.66E-04	1.75E-05	1.13E-05	3.53E-04	5.48E-04	1.35E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.36E-05	5.04E-04	2.55E-05	1.40E-04	1.85E-05	2.39E-04	1.03E-04	3.26E-04	6.31E-05	3.41E-05	2.56E-05	5.49E-05
Caud. Nucl.	1.04E-03	3.61E-02	1.89E-03	9.44E-03	1.38E-03	1.78E-02	1.14E-02	2.57E-02	8.11E-03	4.10E-03	2.75E-03	6.02E-03
Cerebellum	1.56E-06	1.17E-05	2.45E-06	1.26E-05	1.08E-06	2.58E-05	4.73E-06	2.67E-05	9.04E-07	1.09E-06	1.40E-06	2.96E-06
Cereb. Cort.	3.37E-06	2.81E-05	6.02E-06	2.76E-05	3.64E-06	5.55E-05	1.02E-05	5.71E-05	2.33E-06	2.38E-06	3.04E-06	6.38E-06
Cranium	3.28E-06	2.03E-05	7.45E-06	2.22E-05	6.84E-06	4.13E-05	7.94E-06	4.25E-05	4.08E-06	3.86E-06	4.54E-06	5.19E-06
Eyes	2.85E-06	2.31E-05	4.38E-06	2.45E-05	1.67E-06	5.12E-05	9.25E-06	5.27E-05	1.50E-06	1.88E-06	2.44E-06	5.69E-06
Lent. Nucl.	2.57E-05	2.64E-03	5.47E-05	5.07E-04	4.43E-05	5.82E-04	1.37E-04	9.84E-04	3.45E-05	2.56E-05	2.90E-05	5.65E-05
Mandible	2.06E-06	1.23E-05	3.44E-06	1.34E-05	2.09E-06	2.66E-05	5.04E-06	2.73E-05	1.74E-06	2.17E-06	2.59E-06	3.31E-06
Other Tissues	1.34E-06	1.02E-05	2.07E-06	1.09E-05	8.68E-07	2.24E-05	4.10E-06	2.31E-05	7.43E-07	9.13E-07	1.17E-06	2.55E-06
Skin	1.30E-06	1.05E-05	2.02E-06	1.10E-05	7.82E-07	2.29E-05	4.21E-06	2.34E-05	6.72E-07	8.18E-07	1.07E-06	2.61E-06
Spinal Col.	6.79E-07	4.25E-06	9.78E-07	4.72E-06	3.42E-07	9.65E-06	1.82E-06	1.01E-05	3.39E-07	4.44E-07	5.76E-07	1.20E-06
Spinal Skel.	9.46E-07	5.03E-06	1.46E-06	5.36E-06	7.92E-07	1.08E-05	2.11E-06	1.09E-05	7.55E-07	1.03E-06	1.22E-06	1.44E-06
Thalami	1.66E-05	8.06E-04	3.43E-05	1.89E-04	2.72E-05	2.75E-04	5.02E-05	3.52E-04	1.33E-05	1.31E-05	1.60E-05	3.04E-05
Thyroid	6.42E-07	4.91E-06	8.73E-07	5.48E-06	1.91E-07	1.10E-05	1.99E-06	1.16E-05	2.57E-07	3.85E-07	5.10E-07	1.25E-06
Trunk	1.94E-08	2.00E-07	2.55E-08	2.32E-07	2.24E-09	4.64E-07	7.54E-08	4.98E-07	5.66E-09	9.90E-09	1.36E-08	4.30E-08
White Matter	8.48E-06	4.00E-04	1.69E-05	1.06E-04	1.26E-05	1.57E-04	3.21E-05	2.09E-04	8.04E-06	6.96E-06	8.40E-06	1.67E-05

Table B.3: S values for the Newborn Phantom for Sources Located in the Cerebellum.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.01E-04	2.43E-04	3.39E-04	1.46E-04	2.84E-04	1.22E-03	5.40E-04	5.95E-05	7.11E-05	3.36E-04	5.82E-04	1.07E-04
Caud. Nucl.	1.21E-05	1.21E-05	1.22E-05	1.21E-05	4.98E-08	1.35E-05	1.21E-05	2.25E-06	1.50E-06	2.88E-05	1.30E-05	3.19E-08
Cerebellum	3.02E-03	3.70E-03	5.19E-03	2.11E-03	4.67E-03	1.46E-02	8.03E-03	9.47E-04	1.18E-03	4.41E-03	8.50E-03	1.83E-03
Cereb. Cort.	3.87E-05	4.53E-05	6.76E-05	3.29E-05	3.52E-05	7.16E-04	1.53E-04	6.95E-06	4.32E-06	1.31E-04	1.81E-04	4.03E-06
Cranium	5.08E-05	6.89E-05	1.24E-04	3.56E-05	8.67E-05	8.39E-04	2.71E-04	8.08E-06	5.30E-06	1.84E-04	3.07E-04	7.72E-06
Eyes	4.15E-06	4.15E-06	4.16E-06	4.16E-06	5.77E-09	4.50E-06	4.12E-06	7.68E-07	3.84E-07	9.90E-06	4.45E-06	9.81E-09
Lent. Nucl.	1.53E-05	1.53E-05	1.53E-05	1.53E-05	6.47E-08	1.68E-05	1.52E-05	2.82E-06	1.65E-06	3.40E-05	1.63E-05	4.29E-08
Mandible	4.83E-06	4.84E-06	4.85E-06	4.84E-06	1.99E-08	5.37E-06	4.82E-06	8.97E-07	6.21E-07	1.16E-05	5.22E-06	1.37E-08
Other Tissues	1.18E-05	1.20E-05	1.36E-05	1.17E-05	1.67E-06	1.30E-04	2.44E-05	2.17E-06	1.24E-06	3.43E-05	2.95E-05	4.47E-08
Skin	1.48E-05	1.55E-05	1.97E-05	1.44E-05	4.76E-06	2.27E-04	4.26E-05	2.66E-06	1.47E-06	4.65E-05	5.16E-05	8.81E-08
Spinal Col.	1.65E-05	1.65E-05	1.66E-05	1.65E-05	5.71E-08	4.76E-05	1.70E-05	3.05E-06	1.81E-06	3.88E-05	1.90E-05	4.27E-08
Spinal Skel.	1.59E-05	1.61E-05	1.68E-05	1.59E-05	8.11E-07	8.90E-05	2.19E-05	2.94E-06	2.10E-06	3.98E-05	2.55E-05	5.43E-08
Thalami	1.96E-05	1.96E-05	1.97E-05	1.96E-05	8.48E-08	2.17E-05	1.95E-05	3.64E-06	2.35E-06	4.58E-05	2.12E-05	5.47E-08
Thyroid	4.43E-06	4.43E-06	4.44E-06	4.44E-06	6.89E-09	4.73E-06	4.40E-06	8.21E-07	4.53E-07	1.09E-05	4.79E-06	1.04E-08
Trunk	2.87E-07	2.88E-07	2.88E-07	2.88E-07	6.09E-10	3.22E-07	2.86E-07	5.37E-08	2.29E-08	8.10E-07	3.12E-07	7.01E-10
White Matter	2.09E-05	2.09E-05	2.10E-05	2.09E-05	7.98E-08	1.48E-04	2.34E-05	3.87E-06	2.32E-06	5.08E-05	2.81E-05	5.77E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.15E-05	4.46E-04	2.14E-05	1.19E-04	1.54E-05	2.04E-04	9.65E-05	2.86E-04	6.13E-05	3.24E-05	2.35E-05	5.10E-05
Caud. Nucl.	1.67E-06	1.12E-05	2.58E-06	1.24E-05	1.15E-06	2.46E-05	4.62E-06	2.55E-05	9.75E-07	1.17E-06	1.50E-06	2.97E-06
Cerebellum	1.51E-04	6.55E-03	2.80E-04	1.57E-03	2.08E-04	2.68E-03	1.51E-03	3.95E-03	1.03E-03	5.27E-04	3.63E-04	7.90E-04
Cereb. Cort.	3.57E-06	1.32E-04	6.84E-06	4.14E-05	4.69E-06	6.62E-05	1.30E-05	8.26E-05	3.01E-06	2.74E-06	3.37E-06	7.08E-06
Cranium	4.74E-06	2.29E-04	1.31E-05	6.07E-05	1.43E-05	7.49E-05	1.50E-05	1.12E-04	6.89E-06	6.15E-06	6.94E-06	7.59E-06
Eyes	4.04E-07	3.80E-06	5.37E-07	4.07E-06	6.84E-08	8.51E-06	1.47E-06	8.84E-06	1.31E-07	2.18E-07	2.96E-07	8.65E-07
Lent. Nucl.	1.77E-06	1.41E-05	2.91E-06	1.48E-05	1.39E-06	3.05E-05	5.62E-06	3.11E-05	1.09E-06	1.25E-06	1.60E-06	3.47E-06
Mandible	7.14E-07	4.48E-06	9.94E-07	4.93E-06	3.71E-07	1.00E-05	1.82E-06	1.05E-05	4.44E-07	6.69E-07	8.11E-07	1.17E-06
Other Tissues	1.35E-06	2.20E-05	2.24E-06	1.25E-05	1.12E-06	2.40E-05	4.30E-06	2.58E-05	7.91E-07	8.98E-07	1.16E-06	2.63E-06
Skin	1.60E-06	3.78E-05	2.82E-06	1.58E-05	1.59E-06	2.88E-05	5.25E-06	3.17E-05	9.96E-07	1.05E-06	1.35E-06	3.19E-06
Spinal Col.	1.93E-06	1.59E-05	2.95E-06	1.63E-05	1.10E-06	3.31E-05	6.12E-06	3.40E-05	9.63E-07	1.21E-06	1.59E-06	3.82E-06
Spinal Skel.	2.41E-06	2.03E-05	4.45E-06	1.67E-05	3.17E-06	3.23E-05	6.08E-06	3.37E-05	2.28E-06	2.57E-06	3.06E-06	3.95E-06
Thalami	2.55E-06	1.83E-05	4.25E-06	2.02E-05	2.20E-06	4.15E-05	7.52E-06	4.34E-05	1.63E-06	1.79E-06	2.29E-06	4.78E-06
Thyroid	4.77E-07	4.08E-06	6.34E-07	4.45E-06	9.49E-08	9.52E-06	1.62E-06	1.01E-05	1.75E-07	3.01E-07	3.94E-07	9.81E-07
Trunk	2.39E-08	2.66E-07	3.11E-08	3.15E-07	1.37E-09	6.29E-07	9.90E-08	6.83E-07	5.88E-09	1.08E-08	1.53E-08	5.50E-08
White Matter	2.55E-06	2.22E-05	4.54E-06	2.11E-05	2.70E-06	4.26E-05	7.79E-06	4.40E-05	1.74E-06	1.80E-06	2.30E-06	4.83E-06

Table B..4: S values for the Newborn Phantom for Sources Located in the Cerebral Cortex.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.01E-04	2.42E-04	3.35E-04	1.46E-04	2.80E-04	1.16E-03	5.26E-04	5.95E-05	7.10E-05	3.30E-04	5.65E-04	1.07E-04
Caud. Nucl.	2.72E-05	2.73E-05	2.74E-05	2.73E-05	1.10E-07	1.37E-04	2.96E-05	5.05E-06	2.97E-06	6.48E-05	3.44E-05	8.19E-08
Cerebellum	3.83E-05	4.49E-05	6.70E-05	3.25E-05	3.50E-05	7.12E-04	1.52E-04	6.89E-06	4.31E-06	1.30E-04	1.80E-04	4.05E-06
Cereb. Cort.	4.10E-04	4.98E-04	6.85E-04	2.91E-04	6.07E-04	1.73E-03	1.02E-03	1.28E-04	1.59E-04	5.83E-04	1.07E-03	2.43E-04
Cranium	5.86E-05	8.17E-05	1.52E-04	3.89E-05	1.12E-04	8.92E-04	3.39E-04	9.21E-06	5.93E-06	2.16E-04	3.80E-04	1.01E-05
Eyes	1.33E-05	1.34E-05	1.34E-05	1.34E-05	4.80E-08	7.37E-05	1.45E-05	2.48E-06	1.49E-06	3.30E-05	1.70E-05	3.29E-08
Lent. Nucl.	2.82E-05	2.88E-05	3.21E-05	2.79E-05	3.86E-06	3.95E-04	5.71E-05	5.17E-06	3.16E-06	8.10E-05	7.11E-05	1.54E-07
Mandible	8.51E-06	8.57E-06	8.97E-06	8.49E-06	4.46E-07	5.06E-05	1.19E-05	1.57E-06	1.07E-06	2.18E-05	1.40E-05	2.82E-08
Other Tissues	9.29E-06	9.44E-06	1.04E-05	9.23E-06	1.08E-06	8.91E-05	1.74E-05	1.71E-06	9.83E-07	2.61E-05	2.10E-05	3.39E-08
Skin	1.73E-05	1.93E-05	3.00E-05	1.61E-05	1.26E-05	3.14E-04	7.93E-05	2.98E-06	1.64E-06	6.67E-05	9.39E-05	1.83E-07
Spinal Col.	7.64E-06	7.76E-06	8.54E-06	7.60E-06	8.51E-07	8.09E-05	1.51E-05	1.41E-06	8.67E-07	2.20E-05	1.84E-05	2.54E-08
Spinal Skel.	7.37E-06	7.45E-06	8.02E-06	7.34E-06	6.16E-07	6.52E-05	1.26E-05	1.36E-06	1.00E-06	2.02E-05	1.52E-05	2.62E-08
Thalami	2.85E-05	2.85E-05	2.87E-05	2.85E-05	1.69E-07	2.23E-04	3.41E-05	5.27E-06	3.22E-06	6.82E-05	4.12E-05	7.44E-08
Thyroid	3.52E-06	3.53E-06	3.53E-06	3.52E-06	1.52E-08	3.82E-06	3.49E-06	6.55E-07	4.08E-07	9.16E-06	3.81E-06	1.39E-08
Trunk	1.88E-07	1.88E-07	1.88E-07	1.88E-07	4.42E-10	2.10E-07	1.87E-07	3.50E-08	1.52E-08	5.27E-07	2.04E-07	4.50E-10
White Matter	4.42E-05	5.09E-05	7.37E-05	3.83E-05	3.57E-05	7.74E-04	1.63E-04	7.95E-06	4.95E-06	1.46E-04	1.93E-04	4.02E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.16E-05	4.34E-04	2.14E-05	1.18E-04	1.53E-05	2.05E-04	9.65E-05	2.84E-04	6.12E-05	3.24E-05	2.35E-05	5.11E-05
Caud. Nucl.	3.34E-06	2.80E-05	5.88E-06	2.76E-05	3.57E-06	5.52E-05	1.00E-05	5.69E-05	2.33E-06	2.44E-06	3.08E-06	6.12E-06
Cerebellum	3.56E-06	1.31E-04	6.81E-06	4.10E-05	4.66E-06	6.53E-05	1.29E-05	8.15E-05	2.99E-06	2.72E-06	3.35E-06	7.04E-06
Cereb. Cort.	2.13E-05	8.33E-04	3.93E-05	2.15E-04	2.84E-05	3.77E-04	2.05E-04	5.41E-04	1.38E-04	7.10E-05	4.94E-05	1.08E-04
Cranium	4.91E-06	2.85E-04	1.36E-05	6.97E-05	1.49E-05	8.16E-05	1.67E-05	1.29E-04	7.17E-06	6.49E-06	7.27E-06	7.97E-06
Eyes	1.61E-06	1.36E-05	2.35E-06	1.35E-05	7.67E-07	2.74E-05	4.97E-06	2.85E-05	7.42E-07	9.68E-07	1.28E-06	3.10E-06
Lent. Nucl.	3.47E-06	5.22E-05	6.31E-06	2.96E-05	3.96E-06	5.77E-05	1.05E-05	6.16E-05	2.43E-06	2.54E-06	3.21E-06	6.55E-06
Mandible	1.23E-06	1.10E-05	2.07E-06	8.85E-06	1.25E-06	1.73E-05	3.19E-06	1.81E-05	1.00E-06	1.24E-06	1.49E-06	2.05E-06
Other Tissues	1.07E-06	1.58E-05	1.73E-06	9.68E-06	8.14E-07	1.88E-05	3.39E-06	2.00E-05	6.04E-07	7.04E-07	9.11E-07	2.08E-06
Skin	1.79E-06	6.86E-05	3.18E-06	2.04E-05	1.84E-06	3.29E-05	5.87E-06	3.95E-05	1.11E-06	1.17E-06	1.51E-06	3.56E-06
Spinal Col.	9.03E-07	1.37E-05	1.45E-06	7.99E-06	6.13E-07	1.55E-05	2.89E-06	1.65E-05	4.63E-07	5.55E-07	7.31E-07	1.84E-06
Spinal Skel.	1.17E-06	1.16E-05	2.08E-06	7.93E-06	1.44E-06	1.51E-05	2.82E-06	1.60E-05	1.06E-06	1.23E-06	1.47E-06	1.85E-06
Thalami	3.52E-06	3.22E-05	6.35E-06	2.84E-05	3.88E-06	5.73E-05	1.07E-05	5.87E-05	2.47E-06	2.52E-06	3.21E-06	6.70E-06
Thyroid	4.42E-07	3.25E-06	5.91E-07	3.71E-06	1.26E-07	7.69E-06	1.33E-06	8.23E-06	1.78E-07	2.77E-07	3.62E-07	8.30E-07
Trunk	1.58E-08	1.74E-07	2.10E-08	2.06E-07	1.59E-09	4.10E-07	6.48E-08	4.46E-07	4.30E-09	7.48E-09	1.05E-08	3.62E-08
White Matter	4.29E-06	1.41E-04	8.19E-06	4.72E-05	5.62E-06	7.72E-05	1.51E-05	9.42E-05	3.56E-06	3.29E-06	4.06E-06	8.39E-06

Table B.5: S values for the Newborn Phantom for Sources Located in the Cranial CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	8.84E-05	1.10E-04	1.62E-04	6.05E-05	1.25E-04	7.07E-04	2.75E-04	1.97E-05	1.63E-05	1.86E-04	3.01E-04	3.31E-05
Caud. Nucl.	2.07E-05	2.07E-05	2.08E-05	2.07E-05	7.20E-08	6.93E-05	2.15E-05	3.84E-06	2.43E-06	5.03E-05	2.44E-05	5.71E-08
Cerebellum	1.32E-04	1.68E-04	2.52E-04	8.52E-05	2.05E-04	1.04E-03	4.30E-04	2.99E-05	2.52E-05	2.68E-04	4.67E-04	5.48E-05
Cereb. Cort.	1.59E-04	2.05E-04	3.13E-04	1.00E-04	2.61E-04	1.12E-03	5.40E-04	3.64E-05	3.13E-05	3.21E-04	5.83E-04	6.93E-05
Cranium	6.18E-04	7.92E-04	1.10E-03	3.64E-04	1.00E-03	1.83E-03	1.45E-03	1.54E-04	1.40E-04	7.77E-04	1.48E-03	3.32E-04
Eyes	1.48E-05	1.48E-05	1.49E-05	1.48E-05	4.30E-08	1.27E-04	1.72E-05	2.74E-06	1.49E-06	3.60E-05	2.11E-05	3.65E-08
Lent. Nucl.	2.35E-05	2.35E-05	2.36E-05	2.35E-05	9.96E-08	2.29E-04	2.87E-05	4.35E-06	2.54E-06	5.81E-05	3.56E-05	6.47E-08
Mandible	9.89E-06	1.05E-05	1.28E-05	9.58E-06	2.92E-06	8.24E-05	2.22E-05	1.77E-06	1.17E-06	2.83E-05	2.58E-05	7.42E-08
Other Tissues	1.22E-05	1.42E-05	2.24E-05	1.09E-05	1.05E-05	1.69E-04	5.00E-05	2.03E-06	1.14E-06	4.41E-05	5.77E-05	1.84E-07
Skin	3.66E-05	6.29E-05	1.39E-04	2.07E-05	1.10E-04	5.35E-04	2.84E-04	3.85E-06	2.10E-06	1.61E-04	3.07E-04	2.03E-06
Spinal Col.	9.97E-06	1.13E-05	1.71E-05	9.19E-06	7.21E-06	1.41E-04	3.89E-05	1.71E-06	1.02E-06	3.58E-05	4.52E-05	1.23E-07
Spinal Skel.	9.58E-06	1.07E-05	1.55E-05	8.91E-06	6.05E-06	1.23E-04	3.33E-05	1.65E-06	1.15E-06	3.23E-05	3.87E-05	1.10E-07
Thalami	2.18E-05	2.19E-05	2.19E-05	2.19E-05	8.16E-08	1.04E-04	2.33E-05	4.04E-06	2.49E-06	5.26E-05	2.69E-05	5.88E-08
Thyroid	4.41E-06	4.42E-06	4.43E-06	4.42E-06	1.22E-08	4.95E-06	4.39E-06	8.20E-07	4.16E-07	1.07E-05	4.72E-06	1.01E-08
Trunk	1.87E-07	1.88E-07	1.88E-07	1.88E-07	4.55E-10	2.08E-07	1.86E-07	3.49E-08	1.49E-08	5.10E-07	2.03E-07	4.63E-10
White Matter	2.44E-05	2.45E-05	2.47E-05	2.45E-05	2.20E-07	3.47E-04	3.53E-05	4.53E-06	2.63E-06	6.49E-05	4.59E-05	6.83E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.08E-06	2.29E-04	7.74E-06	6.45E-05	4.66E-06	1.01E-04	3.17E-05	1.44E-04	9.19E-06	3.98E-06	4.45E-06	1.21E-05
Caud. Nucl.	2.67E-06	2.03E-05	4.57E-06	2.16E-05	2.55E-06	4.37E-05	7.87E-06	4.58E-05	1.75E-06	1.84E-06	2.36E-06	4.95E-06
Cerebellum	4.90E-06	3.56E-04	9.58E-06	9.13E-05	5.90E-06	1.37E-04	4.69E-05	2.06E-04	1.40E-05	5.29E-06	5.72E-06	1.65E-05
Cereb. Cort.	5.43E-06	4.45E-04	1.05E-05	1.09E-04	6.27E-06	1.59E-04	5.68E-05	2.46E-04	1.72E-05	6.18E-06	6.55E-06	1.94E-05
Cranium	1.39E-05	1.17E-03	3.42E-05	3.15E-04	2.78E-05	5.01E-04	2.31E-04	7.95E-04	7.97E-05	2.49E-05	2.44E-05	6.76E-05
Eyes	1.58E-06	1.63E-05	2.38E-06	1.44E-05	8.17E-07	2.96E-05	5.34E-06	3.03E-05	7.65E-07	9.96E-07	1.30E-06	3.24E-06
Lent. Nucl.	2.79E-06	2.73E-05	4.97E-06	2.35E-05	2.96E-06	4.65E-05	8.67E-06	4.75E-05	1.91E-06	2.02E-06	2.56E-06	5.37E-06
Mandible	1.34E-06	1.97E-05	2.34E-06	1.07E-05	1.51E-06	1.96E-05	3.59E-06	2.14E-05	1.12E-06	1.34E-06	1.61E-06	2.28E-06
Other Tissues	1.24E-06	4.30E-05	2.08E-06	1.45E-05	1.06E-06	2.31E-05	4.00E-06	2.86E-05	7.23E-07	8.21E-07	1.06E-06	2.43E-06
Skin	2.28E-06	2.34E-04	4.16E-06	5.21E-05	2.56E-06	5.15E-05	7.59E-06	9.82E-05	1.43E-06	1.53E-06	1.95E-06	4.51E-06
Spinal Col.	1.11E-06	3.36E-05	1.76E-06	1.17E-05	7.97E-07	1.91E-05	3.42E-06	2.31E-05	5.99E-07	7.23E-07	9.35E-07	2.13E-06
Spinal Skel.	1.32E-06	2.90E-05	2.52E-06	1.13E-05	1.88E-06	1.85E-05	3.39E-06	2.18E-05	1.28E-06	1.44E-06	1.71E-06	2.19E-06
Thalami	2.75E-06	2.20E-05	4.72E-06	2.20E-05	2.67E-06	4.41E-05	8.17E-06	4.54E-05	1.81E-06	1.93E-06	2.46E-06	5.11E-06
Thyroid	4.64E-07	4.06E-06	6.44E-07	4.49E-06	1.68E-07	8.80E-06	1.55E-06	9.14E-06	1.90E-07	2.56E-07	3.43E-07	9.05E-07
Trunk	1.55E-08	1.73E-07	2.06E-08	2.01E-07	1.57E-09	4.01E-07	6.42E-08	4.31E-07	4.29E-09	7.55E-09	1.05E-08	3.57E-08
White Matter	2.89E-06	3.36E-05	5.27E-06	2.49E-05	3.26E-06	4.95E-05	9.05E-06	5.12E-05	1.97E-06	2.00E-06	2.55E-06	5.57E-06

Table B.6: S values for the Newborn Phantom for Sources Located in the Cranium.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	5.45E-05	2.48E-08	4.04E-05	2.33E-06	9.65E-05	3.17E-06	1.95E-06	1.23E-05	6.30E-06	1.27E-05	7.02E-05	1.75E-07
Caud. Nucl.	8.65E-08	2.13E-09	6.83E-08	8.67E-09	1.83E-07	2.43E-06	1.33E-06	7.53E-06	1.83E-06	4.68E-07	1.23E-06	1.29E-07
Cerebellum	8.80E-05	3.19E-08	6.52E-05	3.68E-06	1.55E-04	3.54E-06	2.34E-06	1.47E-05	8.95E-06	2.01E-05	1.12E-04	1.97E-07
Cereb. Cort.	1.15E-04	5.18E-08	8.49E-05	4.91E-06	2.02E-04	3.68E-06	2.38E-06	1.64E-05	1.11E-05	2.62E-05	1.46E-04	2.07E-07
Cranium	1.61E-03	3.29E-04	1.47E-03	7.51E-04	1.72E-03	7.55E-05	4.31E-05	7.61E-04	1.04E-03	1.14E-03	1.68E-03	2.03E-02
Eyes	4.55E-08	1.55E-10	3.14E-08	2.23E-09	5.12E-07	1.63E-06	4.81E-07	5.38E-06	9.75E-07	2.92E-07	9.43E-07	8.79E-08
Lent. Nucl.	8.93E-08	1.74E-09	6.57E-08	8.71E-09	5.72E-07	2.72E-06	1.52E-06	8.41E-06	2.01E-06	5.13E-07	1.42E-06	1.45E-07
Mandible	6.26E-06	4.31E-08	4.70E-06	4.53E-07	1.12E-05	1.34E-06	9.16E-07	4.02E-06	2.00E-06	1.91E-06	8.52E-06	6.94E-08
Other Tissues	2.56E-05	2.17E-07	1.98E-05	2.22E-06	4.05E-05	1.32E-06	6.11E-07	6.23E-06	4.10E-06	7.66E-06	3.12E-05	8.42E-08
Skin	2.67E-04	3.70E-06	2.20E-04	3.77E-05	3.35E-04	3.17E-06	1.55E-06	4.44E-05	5.45E-05	1.05E-04	2.87E-04	3.85E-07
Spinal Col.	1.82E-05	1.32E-07	1.39E-05	1.49E-06	2.99E-05	1.05E-06	4.58E-07	4.74E-06	2.87E-06	5.29E-06	2.26E-05	6.53E-08
Spinal Skel.	1.50E-05	1.15E-07	1.15E-05	1.16E-06	2.49E-05	1.40E-06	1.15E-06	4.61E-06	3.20E-06	4.39E-06	1.89E-05	7.58E-08
Thalami	8.35E-08	3.28E-10	6.35E-08	5.63E-09	2.08E-07	2.54E-06	1.35E-06	7.76E-06	1.86E-06	4.80E-07	1.26E-06	1.35E-07
Thyroid	1.55E-08	3.24E-09	1.01E-08	2.32E-09	2.98E-08	4.36E-07	7.40E-08	1.58E-06	2.07E-07	7.32E-08	2.39E-07	2.53E-08
Trunk	4.90E-10	2.06E-12	3.90E-10	3.62E-11	8.57E-10	1.55E-08	1.06E-09	6.35E-08	6.54E-09	2.58E-09	9.79E-09	8.69E-10
White Matter	1.49E-07	1.20E-09	9.39E-08	8.52E-09	1.33E-06	2.73E-06	1.56E-06	8.58E-06	2.00E-06	5.11E-07	1.70E-06	1.47E-07

Table B.7: S values for the Newborn Phantom for Sources Located in the Lateral Ventricles.

Targets	S values (mGy MBq^{-1}s^{-1})											
	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.25E-04	2.70E-04	3.74E-04	1.68E-04	2.98E-04	1.61E-03	6.11E-04	6.39E-05	7.39E-05	4.09E-04	6.67E-04	1.09E-04
Caud. Nucl.	1.28E-04	1.30E-04	1.63E-04	1.28E-04	3.09E-05	5.63E-03	5.77E-04	2.38E-05	1.43E-05	5.66E-04	7.79E-04	4.59E-07
Cerebellum	2.14E-05	2.14E-05	2.14E-05	2.14E-05	7.53E-08	2.42E-05	2.13E-05	3.95E-06	2.44E-06	4.93E-05	2.30E-05	5.73E-08
Cereb. Cort.	3.23E-05	3.26E-05	3.46E-05	3.23E-05	2.12E-06	3.39E-04	5.36E-05	5.97E-06	3.61E-06	8.67E-05	6.58E-05	1.04E-07
Cranium	1.90E-05	1.91E-05	1.91E-05	1.90E-05	1.12E-07	2.14E-05	1.90E-05	3.52E-06	2.63E-06	4.36E-05	2.05E-05	6.06E-08
Eyes	1.48E-05	1.48E-05	1.49E-05	1.48E-05	4.36E-08	1.64E-05	1.47E-05	2.74E-06	1.59E-06	3.33E-05	1.58E-05	3.73E-08
Lent. Nucl.	8.82E-05	8.92E-05	9.84E-05	8.79E-05	9.45E-06	2.16E-03	2.05E-04	1.63E-05	1.01E-05	2.79E-04	2.73E-04	3.06E-07
Mandible	9.35E-06	9.37E-06	9.40E-06	9.37E-06	4.07E-08	1.05E-05	9.33E-06	1.73E-06	1.30E-06	2.17E-05	1.01E-05	2.62E-08
Other Tissues	9.64E-06	9.65E-06	9.67E-06	9.65E-06	3.04E-08	1.07E-05	9.59E-06	1.79E-06	1.07E-06	2.22E-05	1.04E-05	2.52E-08
Skin	1.12E-05	1.12E-05	1.12E-05	1.12E-05	3.17E-08	1.23E-05	1.11E-05	2.07E-06	1.18E-06	2.49E-05	1.20E-05	2.87E-08
Spinal Col.	7.90E-06	7.91E-06	7.93E-06	7.92E-06	2.47E-08	8.54E-06	7.84E-06	1.46E-06	9.28E-07	1.75E-05	8.39E-06	2.23E-08
Spinal Skel.	7.37E-06	7.38E-06	7.40E-06	7.38E-06	3.51E-08	8.23E-06	7.35E-06	1.36E-06	1.08E-06	1.68E-05	7.94E-06	2.15E-08
Thalami	1.42E-04	1.53E-04	2.07E-04	1.35E-04	6.73E-05	5.05E-03	5.62E-04	2.54E-05	1.52E-05	5.56E-04	7.32E-04	2.83E-06
Thyroid	3.95E-06	3.95E-06	3.96E-06	3.96E-06	8.19E-09	4.41E-06	3.93E-06	7.38E-07	5.20E-07	9.73E-06	4.30E-06	9.23E-09
Trunk	2.61E-07	2.61E-07	2.62E-07	2.62E-07	5.32E-10	2.91E-07	2.59E-07	4.87E-08	2.06E-08	7.36E-07	2.83E-07	6.38E-10
White Matter	1.00E-04	1.22E-04	1.93E-04	8.07E-05	1.14E-04	1.83E-03	4.38E-04	1.79E-05	1.16E-05	3.42E-04	5.11E-04	1.33E-05

Targets	S values (mGy MBq^{-1}s^{-1})											
	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.42E-05	5.08E-04	2.67E-05	1.44E-04	1.93E-05	2.48E-04	1.05E-04	3.36E-04	6.36E-05	3.46E-05	2.62E-05	5.60E-05
Caud. Nucl.	1.63E-05	5.26E-04	3.39E-05	1.51E-04	2.68E-05	2.63E-04	4.82E-05	2.92E-04	1.29E-05	1.21E-05	1.51E-05	3.01E-05
Cerebellum	2.66E-06	1.98E-05	4.57E-06	2.15E-05	2.53E-06	4.32E-05	8.01E-06	4.45E-05	1.78E-06	1.90E-06	2.42E-06	5.02E-06
Cereb. Cort.	4.00E-06	4.95E-05	7.27E-06	3.35E-05	4.58E-06	6.54E-05	1.20E-05	6.84E-05	2.84E-06	2.89E-06	3.66E-06	7.49E-06
Cranium	3.03E-06	1.82E-05	6.59E-06	2.05E-05	5.76E-06	3.88E-05	7.42E-06	4.00E-05	3.67E-06	3.63E-06	4.26E-06	4.87E-06
Eyes	1.69E-06	1.36E-05	2.42E-06	1.43E-05	6.97E-07	2.95E-05	5.44E-06	3.02E-05	7.67E-07	1.07E-06	1.40E-06	3.37E-06
Lent. Nucl.	1.14E-05	1.91E-04	2.26E-05	9.52E-05	1.67E-05	1.78E-04	3.32E-05	1.88E-04	8.87E-06	8.32E-06	1.05E-05	2.08E-05
Mandible	1.49E-06	8.72E-06	2.31E-06	9.51E-06	1.21E-06	1.90E-05	3.60E-06	1.96E-05	1.14E-06	1.52E-06	1.82E-06	2.39E-06
Other Tissues	1.16E-06	8.89E-06	1.75E-06	9.54E-06	6.78E-07	1.96E-05	3.57E-06	2.02E-05	6.21E-07	7.87E-07	1.01E-06	2.22E-06
Skin	1.26E-06	1.03E-05	1.94E-06	1.08E-05	7.55E-07	2.25E-05	4.10E-06	2.30E-05	6.61E-07	8.12E-07	1.06E-06	2.52E-06
Spinal Col.	1.01E-06	7.23E-06	1.45E-06	7.49E-06	4.67E-07	1.53E-05	2.97E-06	1.54E-05	4.69E-07	6.19E-07	8.14E-07	1.90E-06
Spinal Skel.	1.25E-06	6.89E-06	1.98E-06	7.49E-06	1.11E-06	1.51E-05	2.88E-06	1.55E-05	1.00E-06	1.32E-06	1.57E-06	1.94E-06
Thalami	1.69E-05	5.07E-04	3.49E-05	1.64E-04	2.73E-05	2.77E-04	5.09E-05	3.18E-04	1.36E-05	1.28E-05	1.58E-05	3.12E-05
Thyroid	5.82E-07	3.67E-06	7.81E-07	4.26E-06	2.10E-07	8.63E-06	1.54E-06	9.27E-06	2.65E-07	3.89E-07	5.01E-07	1.00E-06
Trunk	2.16E-08	2.41E-07	2.85E-08	2.87E-07	2.05E-09	5.64E-07	8.93E-08	6.10E-07	5.91E-09	1.04E-08	1.45E-08	4.95E-08
White Matter	8.83E-06	3.75E-04	1.76E-05	1.07E-04	1.29E-05	1.62E-04	3.30E-05	2.12E-04	8.31E-06	7.20E-06	8.73E-06	1.74E-05

Table B.8: S values for the Newborn Phantom for Sources Located in the Lentiform Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.18E-04	2.63E-04	3.67E-04	1.61E-04	2.98E-04	1.55E-03	6.03E-04	6.25E-05	7.31E-05	3.91E-04	6.57E-04	1.09E-04
Caud. Nucl.	4.69E-04	6.54E-04	1.25E-03	2.97E-04	9.72E-04	1.02E-02	3.14E-03	8.24E-05	5.72E-05	1.87E-03	3.60E-03	1.20E-04
Cerebellum	1.47E-05	1.47E-05	1.47E-05	1.47E-05	4.89E-08	1.62E-05	1.46E-05	2.72E-06	1.68E-06	3.39E-05	1.58E-05	3.97E-08
Cereb. Cort.	2.87E-05	2.94E-05	3.26E-05	2.84E-05	3.87E-06	3.91E-04	5.74E-05	5.27E-06	3.18E-06	8.22E-05	7.13E-05	1.65E-07
Cranium	2.20E-05	2.21E-05	2.22E-05	2.21E-05	1.45E-07	1.88E-04	2.59E-05	4.08E-06	3.02E-06	5.40E-05	3.17E-05	7.45E-08
Eyes	2.13E-05	2.13E-05	2.14E-05	2.13E-05	6.95E-08	2.35E-05	2.12E-05	3.94E-06	2.40E-06	4.81E-05	2.29E-05	5.43E-08
Lent. Nucl.	1.26E-02	1.53E-02	2.07E-02	8.79E-03	1.92E-02	3.54E-02	2.91E-02	4.12E-03	5.26E-03	1.53E-02	3.00E-02	8.10E-03
Mandible	1.80E-05	1.81E-05	1.81E-05	1.81E-05	8.80E-08	3.09E-05	1.82E-05	3.34E-06	2.49E-06	4.12E-05	1.99E-05	5.39E-08
Other Tissues	1.61E-05	1.61E-05	1.62E-05	1.61E-05	5.49E-08	5.54E-05	1.68E-05	2.98E-06	1.82E-06	3.78E-05	1.90E-05	4.35E-08
Skin	1.12E-05	1.12E-05	1.12E-05	1.12E-05	3.46E-08	1.23E-05	1.11E-05	2.07E-06	1.19E-06	2.51E-05	1.20E-05	2.91E-08
Spinal Col.	7.18E-06	7.19E-06	7.21E-06	7.19E-06	3.19E-08	7.93E-06	7.13E-06	1.33E-06	8.45E-07	1.55E-05	7.65E-06	2.22E-08
Spinal Skel.	7.84E-06	7.85E-06	7.88E-06	7.85E-06	4.18E-08	8.80E-06	7.83E-06	1.45E-06	1.21E-06	1.75E-05	8.44E-06	2.43E-08
Thalami	5.74E-04	7.94E-04	1.50E-03	3.72E-04	1.16E-03	1.35E-02	3.86E-03	1.01E-04	6.93E-05	2.33E-03	4.46E-03	1.42E-04
Thyroid	6.47E-06	6.48E-06	6.50E-06	6.48E-06	2.03E-08	7.49E-06	6.44E-06	1.20E-06	8.07E-07	1.69E-05	7.07E-06	1.61E-08
Trunk	3.07E-07	3.07E-07	3.08E-07	3.07E-07	7.31E-10	3.41E-07	3.05E-07	5.72E-08	2.68E-08	8.30E-07	3.33E-07	7.41E-10
White Matter	7.58E-05	9.01E-05	1.37E-04	6.30E-05	7.51E-05	1.45E-03	3.05E-04	1.36E-05	8.76E-06	2.54E-04	3.61E-04	9.02E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.33E-05	5.00E-04	2.49E-05	1.37E-04	1.79E-05	2.34E-04	1.02E-04	3.21E-04	6.28E-05	3.39E-05	2.53E-05	5.43E-05
Caud. Nucl.	2.59E-05	2.64E-03	5.47E-05	5.08E-04	4.39E-05	5.86E-04	1.38E-04	9.90E-04	3.43E-05	2.54E-05	2.88E-05	5.68E-05
Cerebellum	1.82E-06	1.36E-05	2.91E-06	1.47E-05	1.35E-06	2.97E-05	5.49E-06	3.06E-05	1.09E-06	1.28E-06	1.64E-06	3.44E-06
Cereb. Cort.	3.50E-06	5.25E-05	6.37E-06	3.02E-05	4.01E-06	5.77E-05	1.06E-05	6.14E-05	2.45E-06	2.53E-06	3.20E-06	6.59E-06
Cranium	3.59E-06	2.53E-05	8.50E-06	2.43E-05	8.16E-06	4.48E-05	8.60E-06	4.61E-05	4.60E-06	4.21E-06	4.94E-06	5.60E-06
Eyes	2.61E-06	1.96E-05	3.74E-06	2.06E-05	1.17E-06	4.31E-05	7.92E-06	4.42E-05	1.24E-06	1.68E-06	2.18E-06	4.96E-06
Lent. Nucl.	6.11E-04	2.35E-02	1.12E-03	5.85E-03	8.21E-04	1.06E-02	6.54E-03	1.55E-02	4.60E-03	2.34E-03	1.58E-03	3.45E-03
Mandible	2.86E-06	1.72E-05	5.23E-06	1.86E-05	3.70E-06	3.64E-05	6.99E-06	3.73E-05	2.71E-06	3.08E-06	3.67E-06	4.62E-06
Other Tissues	2.00E-06	1.57E-05	3.27E-06	1.61E-05	1.63E-06	3.28E-05	6.02E-06	3.38E-05	1.22E-06	1.39E-06	1.78E-06	3.76E-06
Skin	1.28E-06	1.03E-05	1.92E-06	1.08E-05	6.79E-07	2.27E-05	4.12E-06	2.33E-05	6.28E-07	7.99E-07	1.05E-06	2.54E-06
Spinal Col.	9.21E-07	6.59E-06	1.40E-06	6.80E-06	5.75E-07	1.41E-05	2.69E-06	1.42E-05	5.17E-07	6.52E-07	8.32E-07	1.72E-06
Spinal Skel.	1.41E-06	7.35E-06	2.34E-06	7.95E-06	1.47E-06	1.58E-05	3.12E-06	1.62E-05	1.24E-06	1.57E-06	1.86E-06	2.14E-06
Thalami	3.31E-05	3.25E-03	7.06E-05	6.26E-04	5.76E-05	7.32E-04	1.70E-04	1.21E-03	4.29E-05	3.21E-05	3.65E-05	7.14E-05
Thyroid	8.56E-07	6.03E-06	1.26E-06	6.94E-06	4.18E-07	1.44E-05	2.54E-06	1.55E-05	4.01E-07	5.05E-07	6.72E-07	1.64E-06
Trunk	2.82E-08	2.83E-07	3.75E-08	3.29E-07	4.19E-09	6.60E-07	1.08E-07	7.10E-07	8.68E-09	1.46E-08	2.00E-08	6.17E-08
White Matter	7.02E-06	2.64E-04	1.38E-05	8.04E-05	9.90E-06	1.26E-04	2.55E-05	1.60E-04	6.34E-06	5.61E-06	6.85E-06	1.37E-05

Table B.9: S values for the Newborn Phantom for Sources Located in the Spinal CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	9.71E-06	9.76E-06	1.01E-05	9.70E-06	3.75E-07	4.96E-05	1.28E-05	1.79E-06	1.05E-06	2.45E-05	1.48E-05	2.82E-08
Caud. Nucl.	8.43E-06	8.44E-06	8.46E-06	8.44E-06	2.44E-08	9.76E-06	8.37E-06	1.56E-06	9.42E-07	1.91E-05	9.05E-06	2.07E-08
Cerebellum	1.66E-05	1.66E-05	1.67E-05	1.66E-05	6.44E-08	5.64E-05	1.75E-05	3.08E-06	1.80E-06	3.97E-05	1.98E-05	4.40E-08
Cereb. Cort.	9.48E-06	9.59E-06	1.04E-05	9.44E-06	8.28E-07	8.26E-05	1.63E-05	1.75E-06	1.00E-06	2.60E-05	1.96E-05	3.11E-08
Cranium	1.65E-05	1.99E-05	2.96E-05	1.33E-05	1.71E-05	1.57E-04	5.47E-05	2.99E-06	2.16E-06	4.69E-05	6.13E-05	2.37E-06
Eyes	5.00E-06	5.01E-06	5.02E-06	5.01E-06	1.51E-08	5.58E-06	4.97E-06	9.26E-07	4.90E-07	1.18E-05	5.37E-06	1.29E-08
Lent. Nucl.	1.22E-05	1.23E-05	1.23E-05	1.23E-05	3.54E-08	1.36E-05	1.22E-05	2.27E-06	1.41E-06	2.85E-05	1.32E-05	3.10E-08
Mandible	9.33E-06	9.34E-06	9.37E-06	9.34E-06	4.16E-08	1.05E-05	9.30E-06	1.73E-06	1.22E-06	2.16E-05	1.01E-05	2.62E-08
Other Tissues	2.74E-05	2.75E-05	2.75E-05	2.75E-05	9.00E-08	1.95E-04	3.05E-05	5.08E-06	2.98E-06	6.68E-05	3.66E-05	7.25E-08
Skin	1.17E-05	1.17E-05	1.17E-05	1.17E-05	3.13E-08	3.20E-05	1.20E-05	2.15E-06	1.19E-06	2.60E-05	1.33E-05	2.93E-08
Spinal Col.	2.26E-03	3.50E-03	7.24E-03	1.14E-03	6.25E-03	2.58E-02	1.64E-02	3.82E-04	2.74E-04	8.35E-03	1.78E-02	7.52E-04
Spinal Skel.	3.47E-04	4.66E-04	8.51E-04	2.40E-04	6.20E-04	9.11E-03	2.14E-03	6.02E-05	4.37E-05	1.39E-03	2.50E-03	7.13E-05
Thalami	1.56E-05	1.56E-05	1.57E-05	1.57E-05	5.05E-08	1.73E-05	1.56E-05	2.89E-06	1.77E-06	3.64E-05	1.68E-05	4.10E-08
Thyroid	3.84E-05	3.84E-05	3.85E-05	3.84E-05	1.07E-07	4.29E-05	3.81E-05	7.10E-06	4.23E-06	8.94E-05	4.12E-05	1.06E-07
Trunk	2.86E-06	2.93E-06	3.17E-06	2.80E-06	3.73E-07	1.35E-05	4.13E-06	5.28E-07	2.93E-07	7.39E-06	4.71E-06	4.68E-08
White Matter	8.91E-06	8.92E-06	8.94E-06	8.92E-06	2.73E-08	2.19E-05	9.10E-06	1.65E-06	9.83E-07	2.10E-05	1.01E-05	2.34E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.14E-06	1.18E-05	1.71E-06	9.79E-06	6.28E-07	1.98E-05	3.57E-06	2.07E-05	5.70E-07	7.39E-07	9.60E-07	2.21E-06
Caud. Nucl.	1.05E-06	7.74E-06	1.45E-06	8.23E-06	4.10E-07	1.72E-05	3.10E-06	1.77E-05	4.78E-07	6.79E-07	8.80E-07	1.93E-06
Cerebellum	1.95E-06	1.63E-05	2.97E-06	1.66E-05	1.16E-06	3.38E-05	6.13E-06	3.50E-05	1.01E-06	1.27E-06	1.65E-06	3.79E-06
Cereb. Cort.	1.09E-06	1.48E-05	1.66E-06	9.76E-06	6.54E-07	1.93E-05	3.46E-06	2.04E-05	5.56E-07	7.02E-07	9.13E-07	2.12E-06
Cranium	1.73E-06	4.67E-05	3.40E-06	1.69E-05	2.65E-06	2.66E-05	5.58E-06	3.39E-05	1.94E-06	1.95E-06	2.27E-06	3.01E-06
Eyes	5.11E-07	4.58E-06	6.70E-07	4.88E-06	6.71E-08	1.02E-05	1.81E-06	1.06E-05	1.50E-07	2.56E-07	3.54E-07	1.09E-06
Lent. Nucl.	1.52E-06	1.13E-05	2.19E-06	1.21E-05	6.96E-07	2.51E-05	4.59E-06	2.59E-05	7.37E-07	1.01E-06	1.31E-06	2.90E-06
Mandible	1.40E-06	8.66E-06	2.03E-06	9.37E-06	8.87E-07	1.91E-05	3.52E-06	1.98E-05	9.58E-07	1.39E-06	1.67E-06	2.28E-06
Other Tissues	3.21E-06	2.88E-05	5.00E-06	2.73E-05	2.07E-06	5.59E-05	1.01E-05	5.78E-05	1.75E-06	2.10E-06	2.73E-06	6.27E-06
Skin	1.27E-06	1.11E-05	1.91E-06	1.11E-05	6.54E-07	2.32E-05	4.23E-06	2.37E-05	6.07E-07	7.70E-07	1.02E-06	2.58E-06
Spinal Col.	6.86E-05	1.35E-02	1.48E-04	2.40E-03	1.20E-04	2.21E-03	5.89E-04	4.69E-03	1.39E-04	8.99E-05	9.40E-05	1.84E-04
Spinal Skel.	2.88E-05	1.82E-03	7.88E-05	4.00E-04	8.41E-05	4.81E-04	1.08E-04	7.43E-04	4.76E-05	3.66E-05	4.14E-05	5.14E-05
Thalami	1.93E-06	1.44E-05	2.85E-06	1.55E-05	1.03E-06	3.16E-05	5.81E-06	3.26E-05	9.89E-07	1.30E-06	1.68E-06	3.65E-06
Thyroid	4.51E-06	3.55E-05	7.22E-06	3.84E-05	3.20E-06	7.82E-05	1.43E-05	8.09E-05	2.60E-06	3.08E-06	3.97E-06	8.89E-06
Trunk	3.03E-07	3.74E-06	4.55E-07	2.92E-06	1.60E-07	5.76E-06	1.02E-06	6.16E-06	1.49E-07	1.91E-07	2.49E-07	6.10E-07
White Matter	1.06E-06	8.47E-06	1.57E-06	8.84E-06	5.36E-07	1.82E-05	3.30E-06	1.89E-05	5.17E-07	6.87E-07	8.94E-07	2.05E-06

Table B.10: S values for the Newborn Phantom for Sources Located in the Spinal Skeleton.

Targets	S values (mGy MBq^{-1}s^{-1})											
	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	3.37E-07	2.60E-10	2.02E-07	2.70E-09	1.20E-06	1.12E-06	3.15E-07	3.55E-06	6.74E-07	2.24E-07	1.15E-06	5.98E-08
Caud. Nucl.	3.91E-08	2.51E-12	2.97E-08	5.11E-10	6.93E-08	1.03E-06	2.31E-07	3.00E-06	6.26E-07	1.92E-07	5.17E-07	5.31E-08
Cerebellum	8.07E-07	4.83E-10	4.93E-07	5.46E-09	2.70E-06	2.01E-06	6.39E-07	6.28E-06	1.24E-06	4.24E-07	2.37E-06	1.08E-07
Cereb. Cort.	6.35E-07	2.58E-10	3.74E-07	2.73E-09	2.34E-06	1.06E-06	3.14E-07	3.41E-06	6.42E-07	2.32E-07	1.71E-06	5.72E-08
Cranium	1.52E-05	1.16E-07	1.16E-05	1.19E-06	2.54E-05	1.69E-06	1.32E-06	5.36E-06	3.53E-06	4.51E-06	1.93E-05	8.91E-08
Eyes	1.61E-08	2.06E-12	1.03E-08	4.20E-10	4.01E-08	5.15E-07	3.96E-08	1.68E-06	2.25E-07	8.40E-08	2.72E-07	2.82E-08
Lent. Nucl.	5.67E-08	4.73E-11	4.34E-08	4.00E-09	9.81E-08	1.48E-06	4.24E-07	4.63E-06	9.21E-07	2.79E-07	7.57E-07	1.57E-01
Mandible	4.61E-08	2.87E-10	3.58E-08	4.32E-09	8.44E-08	1.41E-06	6.00E-07	3.55E-06	1.28E-06	3.25E-07	6.53E-07	6.90E-08
Other Tissues	2.23E-05	1.33E-07	1.63E-05	1.38E-06	4.50E-05	3.59E-06	1.60E-06	1.27E-05	4.46E-06	5.81E-06	3.16E-05	2.01E-07
Skin	2.00E-07	2.72E-10	1.04E-07	3.14E-09	1.44E-06	1.35E-06	4.62E-07	4.46E-06	8.00E-07	2.39E-07	1.21E-06	7.39E-08
Spinal Col.	5.15E-05	1.35E-08	2.53E-05	9.84E-08	2.85E-04	1.93E-05	1.24E-05	6.08E-05	1.45E-05	4.32E-06	1.38E-04	1.05E-06
Spinal Skel.	2.91E-03	3.56E-04	2.48E-03	8.92E-04	3.72E-03	1.04E-04	7.65E-05	9.54E-04	1.27E-03	1.55E-03	3.23E-03	1.78E-05
Thalami	6.75E-08	7.53E-10	4.99E-08	5.27E-09	1.27E-07	1.99E-06	5.73E-07	6.09E-06	1.25E-06	3.73E-07	9.87E-07	1.06E-07
Thyroid	1.12E-07	1.22E-09	8.21E-08	7.81E-09	4.34E-07	4.51E-06	2.07E-06	1.49E-05	3.03E-06	8.14E-07	2.26E-06	2.46E-07
Trunk	3.26E-07	1.89E-09	2.37E-07	2.01E-08	6.71E-07	2.84E-07	7.58E-08	9.71E-07	1.93E-07	1.24E-07	5.81E-07	1.55E-08
White Matter	3.14E-08	2.37E-10	2.41E-08	2.29E-09	7.00E-08	1.03E-06	2.69E-07	3.26E-06	6.16E-07	1.89E-07	5.21E-07	5.50E-08

Table B.11: S values for the Newborn Phantom for Sources Located in the Thalami.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.21E-04	2.66E-04	3.70E-04	1.64E-04	2.98E-04	1.59E-03	6.07E-04	6.31E-05	7.34E-05	3.99E-04	6.62E-04	1.09E-04
Caud. Nucl.	1.48E-04	1.72E-04	2.91E-04	1.32E-04	1.46E-04	5.43E-03	9.30E-04	2.52E-05	1.50E-05	7.18E-04	1.15E-03	4.69E-06
Cerebellum	2.04E-05	2.04E-05	2.05E-05	2.05E-05	7.30E-08	2.26E-05	2.03E-05	3.78E-06	2.29E-06	4.67E-05	2.19E-05	5.66E-08
Cereb. Cort.	2.78E-05	2.78E-05	2.80E-05	2.78E-05	1.66E-07	2.20E-04	3.32E-05	5.14E-06	3.12E-06	6.81E-05	4.03E-05	7.64E-08
Cranium	2.07E-05	2.07E-05	2.08E-05	2.07E-05	1.30E-07	8.11E-05	2.18E-05	3.83E-06	2.91E-06	4.89E-05	2.48E-05	6.77E-08
Eyes	1.65E-05	1.65E-05	1.65E-05	1.65E-05	6.11E-08	1.83E-05	1.64E-05	3.05E-06	1.83E-06	3.84E-05	1.77E-05	4.33E-08
Lent. Nucl.	5.76E-04	7.97E-04	1.51E-03	3.73E-04	1.16E-03	1.35E-02	3.87E-03	1.01E-04	6.94E-05	2.34E-03	4.46E-03	1.42E-04
Mandible	1.49E-05	1.49E-05	1.50E-05	1.49E-05	7.19E-08	1.66E-05	1.49E-05	2.76E-06	2.07E-06	3.41E-05	1.61E-05	4.41E-08
Other Tissues	1.61E-05	1.62E-05	1.62E-05	1.62E-05	5.56E-08	2.64E-05	1.62E-05	2.99E-06	1.82E-06	3.72E-05	1.77E-05	4.35E-08
Skin	1.08E-05	1.08E-05	1.08E-05	1.08E-05	3.12E-08	1.19E-05	1.07E-05	2.00E-06	1.14E-06	2.42E-05	1.16E-05	2.75E-08
Spinal Col.	1.13E-05	1.13E-05	1.13E-05	1.13E-05	2.85E-08	1.23E-05	1.13E-05	2.08E-06	1.33E-06	2.49E-05	1.21E-05	2.72E-08
Spinal Skel.	1.08E-05	1.08E-05	1.08E-05	1.08E-05	5.79E-08	1.21E-05	1.08E-05	1.99E-06	1.64E-06	2.39E-05	1.16E-05	3.26E-08
Thalami	1.45E-02	1.77E-02	2.43E-02	1.01E-02	2.24E-02	4.55E-02	3.48E-02	4.70E-03	5.97E-03	1.83E-02	3.60E-02	9.23E-03
Thyroid	8.40E-06	8.41E-06	8.42E-06	8.42E-06	1.62E-08	9.65E-06	8.35E-06	1.56E-06	7.79E-07	1.95E-05	9.02E-06	2.24E-08
Trunk	3.63E-07	3.64E-07	3.65E-07	3.64E-07	8.48E-10	4.05E-07	3.61E-07	6.78E-08	3.11E-08	9.91E-07	3.94E-07	9.06E-10
White Matter	7.49E-05	8.71E-05	1.28E-04	6.42E-05	6.42E-05	1.47E-03	2.84E-04	1.35E-05	8.60E-06	2.50E-04	3.40E-04	7.42E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.37E-05	5.04E-04	2.56E-05	1.40E-04	1.85E-05	2.40E-04	1.04E-04	3.27E-04	6.32E-05	3.42E-05	2.57E-05	5.50E-05
Caud. Nucl.	1.66E-05	8.11E-04	3.43E-05	1.90E-04	2.72E-05	2.74E-04	4.99E-05	3.53E-04	1.32E-05	1.30E-05	1.59E-05	3.03E-05
Cerebellum	2.50E-06	1.89E-05	4.18E-06	2.04E-05	2.17E-06	4.15E-05	7.61E-06	4.28E-05	1.60E-06	1.76E-06	2.25E-06	4.74E-06
Cereb. Cort.	3.44E-06	3.15E-05	6.16E-06	2.80E-05	3.74E-06	5.63E-05	1.04E-05	5.81E-05	2.39E-06	2.47E-06	3.13E-06	6.47E-06
Cranium	3.43E-06	2.11E-05	7.86E-06	2.28E-05	7.32E-06	4.20E-05	8.10E-06	4.32E-05	4.32E-06	4.07E-06	4.78E-06	5.33E-06
Eyes	1.98E-06	1.51E-05	2.77E-06	1.62E-05	7.48E-07	3.33E-05	6.10E-06	3.43E-05	8.78E-07	1.24E-06	1.63E-06	3.81E-06
Lent. Nucl.	3.31E-05	3.26E-03	7.04E-05	6.29E-04	5.73E-05	7.39E-04	1.71E-04	1.23E-03	4.29E-05	3.22E-05	3.66E-05	7.15E-05
Mandible	2.38E-06	1.40E-05	4.12E-06	1.54E-05	2.69E-06	3.05E-05	5.75E-06	3.16E-05	2.16E-06	2.62E-06	3.11E-06	3.80E-06
Other Tissues	1.99E-06	1.51E-05	3.23E-06	1.61E-05	1.58E-06	3.28E-05	6.01E-06	3.38E-05	1.21E-06	1.39E-06	1.78E-06	3.75E-06
Skin	1.22E-06	9.92E-06	1.84E-06	1.05E-05	6.49E-07	2.18E-05	3.96E-06	2.23E-05	6.13E-07	7.88E-07	1.03E-06	2.44E-06
Spinal Col.	1.46E-06	1.04E-05	2.27E-06	1.09E-05	1.01E-06	2.24E-05	4.24E-06	2.27E-05	8.26E-07	9.68E-07	1.25E-06	2.69E-06
Spinal Skel.	1.90E-06	1.01E-05	3.33E-06	1.10E-05	2.27E-06	2.16E-05	4.27E-06	2.20E-05	1.78E-06	2.13E-06	2.52E-06	2.91E-06
Thalami	6.98E-04	2.81E-02	1.28E-03	6.90E-03	9.44E-04	1.23E-02	7.45E-03	1.81E-02	5.20E-03	2.65E-03	1.79E-03	3.91E-03
Thyroid	8.39E-07	7.73E-06	1.28E-06	8.24E-06	4.66E-07	1.70E-05	2.95E-06	1.75E-05	4.53E-07	5.90E-07	7.55E-07	1.73E-06
Trunk	3.30E-08	3.36E-07	4.36E-08	3.92E-07	4.82E-09	7.85E-07	1.26E-07	8.45E-07	1.03E-08	1.73E-08	2.36E-08	7.17E-08
White Matter	7.38E-06	2.47E-04	1.45E-05	8.00E-05	1.04E-05	1.29E-04	2.56E-05	1.59E-04	6.44E-06	5.81E-06	7.13E-06	1.42E-05

Table B.12: S values for the Newborn Phantom for Sources Located in the Third Ventricle.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.22E-04	2.67E-04	3.71E-04	1.65E-04	2.98E-04	1.60E-03	6.08E-04	6.33E-05	7.36E-05	4.02E-04	6.64E-04	1.09E-04
Caud. Nucl.	1.00E-04	1.00E-04	1.01E-04	1.00E-04	4.56E-07	2.56E-03	1.47E-04	1.85E-05	1.15E-05	2.81E-04	2.14E-04	2.78E-07
Cerebellum	2.10E-05	2.10E-05	2.11E-05	2.10E-05	7.40E-08	2.34E-05	2.09E-05	3.88E-06	2.37E-06	4.75E-05	2.25E-05	5.70E-08
Cereb. Cort.	2.75E-05	2.75E-05	2.76E-05	2.76E-05	1.08E-07	1.48E-04	3.00E-05	5.09E-06	3.11E-06	6.55E-05	3.51E-05	7.55E-08
Cranium	2.01E-05	2.02E-05	2.02E-05	2.01E-05	1.22E-07	4.90E-05	2.06E-05	3.73E-06	2.84E-06	4.71E-05	2.29E-05	6.59E-08
Eyes	1.58E-05	1.58E-05	1.59E-05	1.58E-05	5.39E-08	1.76E-05	1.57E-05	2.93E-06	1.84E-06	3.71E-05	1.70E-05	4.18E-08
Lent. Nucl.	1.57E-04	1.57E-04	1.58E-04	1.57E-04	1.06E-06	7.08E-03	3.16E-04	2.91E-05	1.73E-05	5.11E-04	4.99E-04	4.55E-07
Mandible	1.37E-05	1.37E-05	1.38E-05	1.37E-05	6.43E-08	1.54E-05	1.37E-05	2.54E-06	2.00E-06	3.18E-05	1.48E-05	4.01E-08
Other Tissues	1.55E-05	1.55E-05	1.55E-05	1.55E-05	5.19E-08	2.06E-05	1.54E-05	2.86E-06	1.74E-06	3.54E-05	1.67E-05	4.16E-08
Skin	1.08E-05	1.08E-05	1.08E-05	1.08E-05	3.30E-08	1.18E-05	1.07E-05	1.99E-06	1.13E-06	2.40E-05	1.15E-05	2.87E-08
Spinal Col.	1.12E-05	1.12E-05	1.12E-05	1.12E-05	5.21E-08	1.25E-05	1.11E-05	2.07E-06	1.34E-06	2.55E-05	1.20E-05	3.13E-08
Spinal Skel.	1.08E-05	1.08E-05	1.09E-05	1.08E-05	5.44E-08	1.21E-05	1.08E-05	2.00E-06	1.63E-06	2.42E-05	1.16E-05	3.25E-08
Thalami	6.44E-04	8.66E-04	2.20E-03	5.19E-04	1.52E-03	3.33E-02	8.88E-03	9.79E-05	5.57E-05	5.31E-03	1.06E-02	1.80E-05
Thyroid	6.78E-06	6.79E-06	6.80E-06	6.79E-06	2.35E-08	7.64E-06	6.74E-06	1.27E-06	7.68E-07	1.72E-05	7.31E-06	2.21E-08
Trunk	3.57E-07	3.57E-07	3.58E-07	3.57E-07	8.52E-10	3.96E-07	3.55E-07	6.65E-08	3.07E-08	9.86E-07	3.87E-07	8.98E-10
White Matter	1.57E-04	2.13E-04	3.54E-04	1.02E-04	2.69E-04	1.70E-03	6.54E-04	2.86E-05	2.00E-05	4.26E-04	7.18E-04	4.20E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.39E-05	5.05E-04	2.60E-05	1.41E-04	1.88E-05	2.42E-04	1.04E-04	3.30E-04	6.33E-05	3.43E-05	2.58E-05	5.54E-05
Caud. Nucl.	1.29E-05	1.46E-04	2.62E-05	1.04E-04	1.97E-05	2.04E-04	3.80E-05	2.11E-04	1.03E-05	9.32E-06	1.18E-05	2.39E-05
Cerebellum	2.59E-06	1.95E-05	4.34E-06	2.08E-05	2.28E-06	4.24E-05	7.82E-06	4.35E-05	1.69E-06	1.87E-06	2.37E-06	4.88E-06
Cereb. Cort.	3.43E-06	2.84E-05	6.10E-06	2.78E-05	3.66E-06	5.59E-05	1.03E-05	5.75E-05	2.38E-06	2.45E-06	3.12E-06	6.44E-06
Cranium	3.34E-06	1.99E-05	7.48E-06	2.21E-05	6.81E-06	4.12E-05	7.89E-06	4.27E-05	4.13E-06	3.98E-06	4.67E-06	5.19E-06
Eyes	2.00E-06	1.45E-05	2.75E-06	1.56E-05	7.18E-07	3.27E-05	5.93E-06	3.40E-05	8.76E-07	1.27E-06	1.65E-06	3.74E-06
Lent. Nucl.	1.97E-05	3.17E-04	4.12E-05	1.63E-04	3.25E-05	3.18E-04	5.88E-05	3.28E-04	1.60E-05	1.43E-05	1.79E-05	3.64E-05
Mandible	2.30E-06	1.29E-05	3.89E-06	1.42E-05	2.44E-06	2.80E-05	5.39E-06	2.89E-05	2.00E-06	2.46E-06	2.93E-06	3.63E-06
Other Tissues	1.90E-06	1.44E-05	3.06E-06	1.54E-05	1.45E-06	3.13E-05	5.75E-06	3.23E-05	1.14E-06	1.32E-06	1.69E-06	3.59E-06
Skin	1.22E-06	9.88E-06	1.81E-06	1.04E-05	6.16E-07	2.16E-05	3.93E-06	2.21E-05	5.96E-07	7.70E-07	1.01E-06	2.41E-06
Spinal Col.	1.47E-06	1.03E-05	2.26E-06	1.11E-05	9.54E-07	2.29E-05	4.24E-06	2.37E-05	8.09E-07	9.64E-07	1.25E-06	2.69E-06
Spinal Skel.	1.90E-06	1.02E-05	3.31E-06	1.11E-05	2.25E-06	2.18E-05	4.27E-06	2.23E-05	1.77E-06	2.11E-06	2.50E-06	2.90E-06
Thalami	6.51E-05	7.57E-03	1.43E-04	1.14E-03	1.24E-04	1.14E-03	1.93E-04	1.93E-03	5.24E-05	5.96E-05	6.93E-05	1.18E-04
Thyroid	8.45E-07	6.27E-06	1.24E-06	7.22E-06	4.52E-07	1.41E-05	2.51E-06	1.50E-05	4.61E-07	6.16E-07	7.82E-07	1.56E-06
Trunk	3.25E-08	3.30E-07	4.28E-08	3.88E-07	4.47E-09	7.76E-07	1.25E-07	8.39E-07	9.93E-09	1.69E-08	2.31E-08	7.08E-08
White Matter	8.66E-06	5.45E-04	1.71E-05	1.44E-04	1.23E-05	1.96E-04	4.78E-05	2.99E-04	1.16E-05	8.04E-06	9.30E-06	1.94E-05

Table B.13: S values for the Newborn Phantom for Sources Located in the Thyroid.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{125m}I	^{126}I	^{130}I	^{131}I	^{132}I	^{132m}I	^{133}I
Brain (Total)	4.82E-07	4.10E-06	6.73E-07	4.47E-06	1.62E-07	1.86E-06	1.10E-07	9.21E-06	1.61E-06	9.61E-06	1.38E-06	2.62E-06
Caud. Nucl.	5.96E-07	5.35E-06	8.51E-07	5.65E-06	2.21E-07	2.37E-06	1.50E-07	1.16E-05	2.08E-06	1.19E-05	1.73E-06	3.35E-06
Cerebellum	4.84E-07	4.25E-06	6.41E-07	4.57E-06	9.04E-08	1.89E-06	6.47E-08	9.46E-06	1.67E-06	9.82E-06	1.39E-06	2.71E-06
Cereb. Cort.	4.43E-07	3.84E-06	6.20E-07	4.19E-06	1.48E-07	1.74E-06	1.00E-07	8.60E-06	1.50E-06	8.96E-06	1.28E-06	2.45E-06
Cranium	6.15E-07	4.03E-06	9.65E-07	4.46E-06	5.04E-07	1.90E-06	3.34E-07	8.89E-06	1.62E-06	9.25E-06	1.41E-06	2.54E-06
Eyes	4.22E-07	3.50E-06	5.55E-07	3.86E-06	8.59E-08	1.57E-06	6.10E-08	7.85E-06	1.38E-06	8.22E-06	1.16E-06	2.24E-06
Lent. Nucl.	9.53E-07	7.12E-06	1.36E-06	7.79E-06	4.22E-07	3.31E-06	2.85E-07	1.62E-05	2.87E-06	1.69E-05	2.46E-06	4.56E-06
Mandible	1.19E-06	6.72E-06	2.16E-06	7.30E-06	1.54E-06	3.31E-06	9.89E-07	1.43E-05	2.78E-06	1.45E-05	2.44E-06	4.12E-06
Other Tissues	4.63E-06	3.13E-04	9.16E-06	7.22E-05	6.64E-06	2.77E-05	3.59E-06	9.65E-05	2.10E-05	1.43E-04	2.08E-05	6.22E-05
Skin	1.17E-06	1.67E-05	2.12E-06	9.94E-06	1.31E-06	4.39E-06	6.94E-07	2.01E-05	3.69E-06	2.07E-05	3.23E-06	5.76E-06
Spinal Col.	4.30E-06	3.43E-05	6.96E-06	3.66E-05	3.09E-06	1.59E-05	1.94E-06	7.55E-05	1.39E-05	7.78E-05	1.17E-05	2.16E-05
Spinal Skel.	5.84E-06	3.99E-05	1.27E-05	4.07E-05	1.10E-05	1.86E-05	6.58E-06	7.73E-05	1.47E-05	7.95E-05	1.38E-05	2.22E-05
Thalami	9.41E-07	7.00E-06	1.38E-06	7.69E-06	4.79E-07	3.26E-06	3.20E-07	1.58E-05	2.84E-06	1.66E-05	2.42E-06	4.46E-06
Thyroid	2.19E-03	7.09E-02	3.98E-03	1.89E-02	2.91E-03	1.72E-02	8.29E-03	3.68E-02	2.38E-02	5.23E-02	1.84E-02	4.49E-02
Trunk	5.93E-07	7.49E-06	9.90E-07	5.38E-06	5.05E-07	2.26E-06	2.95E-07	1.05E-05	1.90E-06	1.12E-05	1.67E-06	3.15E-06
White Matter	4.92E-07	4.15E-06	6.87E-07	4.52E-06	1.68E-07	1.89E-06	1.15E-07	9.34E-06	1.63E-06	9.76E-06	1.40E-06	2.65E-06

Table B.14: S values for the Newborn Phantom for Sources Located in the White Matter.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.15E-04	2.60E-04	3.64E-04	1.58E-04	2.98E-04	1.51E-03	5.99E-04	6.21E-05	7.27E-05	3.85E-04	6.52E-04	1.09E-04
Caud. Nucl.	9.70E-05	1.19E-04	1.94E-04	7.74E-05	1.17E-04	2.04E-03	4.63E-04	1.72E-05	1.10E-05	3.51E-04	5.45E-04	1.30E-05
Cerebellum	2.11E-05	2.12E-05	2.12E-05	2.12E-05	7.69E-08	1.46E-04	2.36E-05	3.91E-06	2.31E-06	5.06E-05	2.82E-05	5.76E-08
Cereb. Cort.	4.43E-05	5.10E-05	7.38E-05	3.84E-05	3.58E-05	7.73E-04	1.63E-04	7.97E-06	4.94E-06	1.46E-04	1.93E-04	4.05E-06
Cranium	2.25E-05	2.25E-05	2.27E-05	2.25E-05	1.92E-07	2.86E-04	2.97E-05	4.17E-06	3.00E-06	5.85E-05	3.83E-05	7.46E-08
Eyes	1.62E-05	1.62E-05	1.62E-05	1.62E-05	6.08E-08	2.84E-05	1.63E-05	2.99E-06	1.67E-06	3.68E-05	1.79E-05	4.10E-08
Lent. Nucl.	7.44E-05	8.87E-05	1.36E-04	6.16E-05	7.51E-05	1.42E-03	3.03E-04	1.33E-05	8.78E-06	2.52E-04	3.57E-04	8.84E-06
Mandible	9.26E-06	9.27E-06	9.30E-06	9.27E-06	4.18E-08	1.83E-05	9.40E-06	1.71E-06	1.20E-06	2.15E-05	1.03E-05	2.74E-08
Other Tissues	9.21E-06	9.22E-06	9.25E-06	9.23E-06	2.97E-08	2.64E-05	9.49E-06	1.71E-06	9.93E-07	2.16E-05	1.06E-05	2.45E-08
Skin	1.30E-05	1.30E-05	1.30E-05	1.30E-05	4.22E-08	8.54E-05	1.43E-05	2.40E-06	1.37E-06	3.00E-05	1.70E-05	3.44E-08
Spinal Col.	6.88E-06	6.89E-06	6.91E-06	6.89E-06	2.05E-08	1.87E-05	7.05E-06	1.27E-06	8.02E-07	1.64E-05	7.85E-06	1.63E-08
Spinal Skel.	6.70E-06	6.71E-06	6.73E-06	6.71E-06	3.19E-08	1.66E-05	6.86E-06	1.24E-06	9.44E-07	1.55E-05	7.62E-06	1.96E-08
Thalami	7.23E-05	8.44E-05	1.25E-04	6.16E-05	6.42E-05	1.42E-03	2.81E-04	1.30E-05	8.43E-06	2.46E-04	3.36E-04	7.28E-06
Thyroid	4.24E-06	4.25E-06	4.26E-06	4.25E-06	1.22E-08	4.74E-06	4.20E-06	7.88E-07	3.90E-07	1.01E-05	4.59E-06	1.09E-08
Trunk	2.11E-07	2.11E-07	2.11E-07	2.11E-07	5.15E-10	2.34E-07	2.09E-07	3.93E-08	1.69E-08	5.88E-07	2.28E-07	5.18E-10
White Matter	4.12E-04	5.00E-04	6.97E-04	2.95E-04	5.99E-04	2.36E-03	1.10E-03	1.24E-04	1.51E-04	6.58E-04	1.18E-03	2.29E-04

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.29E-05	4.97E-04	2.42E-05	1.34E-04	1.75E-05	2.28E-04	1.01E-04	3.16E-04	6.26E-05	3.36E-05	2.49E-05	5.37E-05
Caud. Nucl.	8.23E-06	3.97E-04	1.66E-05	1.06E-04	1.24E-05	1.54E-04	3.16E-05	2.06E-04	7.82E-06	6.80E-06	8.20E-06	1.65E-05
Cerebellum	2.54E-06	2.24E-05	4.52E-06	2.12E-05	2.69E-06	4.29E-05	7.84E-06	4.42E-05	1.73E-06	1.78E-06	2.27E-06	4.84E-06
Cereb. Cort.	4.28E-06	1.42E-04	8.16E-06	4.72E-05	5.59E-06	7.73E-05	1.51E-05	9.43E-05	3.55E-06	3.27E-06	4.03E-06	8.37E-06
Cranium	3.57E-06	2.91E-05	8.85E-06	2.53E-05	8.77E-06	4.62E-05	8.77E-06	4.79E-05	4.71E-06	4.17E-06	4.89E-06	5.67E-06
Eyes	1.80E-06	1.51E-05	2.65E-06	1.58E-05	8.79E-07	3.31E-05	5.87E-06	3.43E-05	8.65E-07	1.14E-06	1.49E-06	3.56E-06
Lent. Nucl.	7.11E-06	2.61E-04	1.37E-05	7.97E-05	9.70E-06	1.25E-04	2.52E-05	1.60E-04	6.27E-06	5.65E-06	6.90E-06	1.37E-05
Mandible	1.38E-06	8.81E-06	2.22E-06	9.36E-06	1.25E-06	1.89E-05	3.49E-06	1.95E-05	1.10E-06	1.42E-06	1.70E-06	2.25E-06
Other Tissues	1.08E-06	8.86E-06	1.69E-06	9.13E-06	7.19E-07	1.87E-05	3.39E-06	1.93E-05	5.97E-07	7.27E-07	9.37E-07	2.09E-06
Skin	1.48E-06	1.35E-05	2.44E-06	1.25E-05	1.18E-06	2.58E-05	4.77E-06	2.62E-05	8.48E-07	9.50E-07	1.24E-06	2.94E-06
Spinal Col.	8.65E-07	6.58E-06	1.31E-06	6.85E-06	5.02E-07	1.39E-05	2.60E-06	1.44E-05	4.41E-07	5.55E-07	7.22E-07	1.65E-06
Spinal Skel.	1.09E-06	6.47E-06	1.82E-06	6.85E-06	1.13E-06	1.37E-05	2.60E-06	1.41E-05	9.33E-07	1.17E-06	1.40E-06	1.73E-06
Thalami	7.21E-06	2.44E-04	1.42E-05	7.84E-05	1.03E-05	1.25E-04	2.48E-05	1.56E-04	6.41E-06	5.75E-06	7.04E-06	1.38E-05
Thyroid	4.05E-07	3.91E-06	6.03E-07	4.32E-06	1.69E-07	9.18E-06	1.52E-06	9.75E-06	1.77E-07	2.33E-07	3.12E-07	8.85E-07
Trunk	1.74E-08	1.95E-07	2.33E-08	2.29E-07	1.77E-09	4.55E-07	7.26E-08	4.92E-07	4.74E-09	8.29E-09	1.16E-08	4.05E-08
White Matter	2.27E-05	9.05E-04	4.24E-05	2.34E-04	3.10E-05	4.01E-04	2.01E-04	5.69E-04	1.30E-04	6.84E-05	4.88E-05	1.06E-04

S Values in a Mathematical Model of the Head and Brain of a One-Year-Old

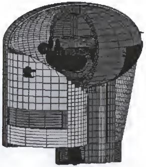


Table B.15: S values for the 1-year-old Phantom for Sources Located in the Brain (total).

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	9.85E-05	1.18E-04	1.62E-04	7.35E-05	1.29E-04	6.27E-04	2.59E-04	2.81E-05	3.26E-05	1.74E-04	2.81E-04	4.79E-05
Caud. Nucl.	1.06E-04	1.26E-04	1.72E-04	8.01E-05	1.33E-04	7.15E-04	2.75E-04	2.93E-05	3.33E-05	1.93E-04	2.99E-04	4.81E-05
Cerebellum	9.63E-05	1.15E-04	1.59E-04	7.14E-05	1.28E-04	6.01E-04	2.54E-04	2.77E-05	3.24E-05	1.67E-04	2.75E-04	4.79E-05
Cereb. Cort.	9.46E-05	1.13E-04	1.56E-04	7.02E-05	1.26E-04	5.54E-04	2.45E-04	2.74E-05	3.22E-05	1.61E-04	2.64E-04	4.76E-05
Cranium	1.78E-05	2.08E-05	3.11E-05	1.56E-05	1.49E-05	2.44E-04	6.61E-05	3.08E-06	2.27E-06	5.94E-05	7.65E-05	1.01E-06
Eyes	9.00E-06	9.01E-06	9.03E-06	9.02E-06	1.91E-08	1.49E-05	9.04E-06	1.67E-06	9.10E-07	2.03E-05	9.87E-06	2.17E-08
Lent. Nucl.	1.03E-04	1.23E-04	1.69E-04	7.83E-05	1.31E-04	7.09E-04	2.74E-04	2.89E-05	3.32E-05	1.90E-04	2.99E-04	4.76E-05
Mandible	3.89E-06	3.90E-06	3.92E-06	3.90E-06	2.82E-08	7.98E-06	4.07E-06	7.21E-07	5.66E-07	9.33E-06	4.49E-06	1.12E-08
Other Tissues	4.62E-06	4.63E-06	4.69E-06	4.63E-06	5.51E-08	1.72E-05	5.33E-06	8.56E-07	5.03E-07	1.12E-05	6.07E-06	1.21E-08
Skin	7.27E-06	7.30E-06	7.90E-06	7.28E-06	5.56E-07	6.45E-05	1.33E-05	1.34E-06	7.40E-07	1.95E-05	1.60E-05	1.95E-08
Spinal Col.	3.89E-06	3.90E-06	3.93E-06	3.90E-06	3.54E-08	1.31E-05	4.39E-06	7.21E-07	4.39E-07	9.93E-06	5.00E-06	1.02E-08
Spinal Skel.	4.01E-06	4.02E-06	4.05E-06	4.02E-06	3.69E-08	1.18E-05	4.39E-06	7.43E-07	6.11E-07	9.41E-06	4.92E-06	1.14E-08
Thalami	1.06E-04	1.26E-04	1.72E-04	8.08E-05	1.32E-04	7.22E-04	2.77E-04	2.95E-05	3.36E-05	1.96E-04	3.02E-04	4.82E-05
Thyroid	1.66E-06	1.67E-06	1.67E-06	1.67E-06	2.32E-09	1.79E-06	1.67E-06	3.10E-07	1.56E-07	4.43E-06	1.84E-06	3.71E-09
Trunk	7.48E-08	7.49E-08	7.50E-08	7.49E-08	1.57E-10	8.39E-08	7.44E-08	1.40E-08	5.41E-09	2.31E-07	8.17E-08	1.80E-10
White Matter	1.03E-04	1.23E-04	1.69E-04	7.70E-05	1.33E-04	7.00E-04	2.74E-04	2.89E-05	3.32E-05	1.87E-04	2.99E-04	4.84E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	6.19E-06	2.15E-04	1.13E-05	6.21E-05	7.77E-06	1.08E-04	4.62E-05	1.46E-04	2.79E-05	1.52E-05	1.14E-05	2.47E-05
Caud. Nucl.	7.02E-06	2.29E-04	1.29E-05	6.97E-05	8.82E-06	1.22E-04	4.86E-05	1.62E-04	2.84E-05	1.57E-05	1.21E-05	2.61E-05
Cerebellum	5.93E-06	2.10E-04	1.08E-05	5.97E-05	7.42E-06	1.04E-04	4.54E-05	1.41E-04	2.77E-05	1.49E-05	1.11E-05	2.42E-05
Cereb. Cort.	5.78E-06	2.03E-04	1.05E-05	5.81E-05	7.21E-06	1.02E-04	4.49E-05	1.38E-04	2.75E-05	1.48E-05	1.10E-05	2.39E-05
Cranium	2.55E-06	5.75E-05	6.23E-06	2.16E-05	6.23E-06	3.24E-05	6.28E-06	3.97E-05	3.37E-06	3.19E-06	3.69E-06	3.88E-06
Eyes	9.86E-07	8.35E-06	1.34E-06	8.69E-06	2.81E-07	1.83E-05	3.25E-06	1.89E-05	3.69E-07	5.34E-07	7.22E-07	1.96E-06
Lent. Nucl.	6.94E-06	2.28E-04	1.26E-05	6.79E-05	8.63E-06	1.18E-04	4.80E-05	1.57E-04	2.83E-05	1.57E-05	1.21E-05	2.59E-05
Mandible	6.69E-07	3.78E-06	8.94E-07	3.94E-06	3.18E-07	7.96E-06	1.51E-06	8.25E-06	3.89E-07	5.93E-07	7.24E-07	1.01E-06
Other Tissues	5.47E-07	4.93E-06	7.93E-07	4.60E-06	2.55E-07	9.44E-06	1.70E-06	9.79E-06	2.53E-07	3.39E-07	4.45E-07	1.05E-06
Skin	7.92E-07	1.21E-05	1.25E-06	7.26E-06	5.12E-07	1.46E-05	2.64E-06	1.52E-05	4.01E-07	4.74E-07	6.27E-07	1.61E-06
Spinal Col.	4.79E-07	4.08E-06	6.78E-07	3.96E-06	2.02E-07	8.14E-06	1.45E-06	8.54E-06	2.14E-07	2.94E-07	3.86E-07	9.04E-07
Spinal Skel.	7.30E-07	4.09E-06	1.03E-06	4.02E-06	4.59E-07	8.13E-06	1.57E-06	8.37E-06	4.89E-07	7.05E-07	8.49E-07	1.07E-06
Thalami	7.23E-06	2.31E-04	1.31E-05	7.00E-05	8.91E-06	1.22E-04	4.91E-05	1.61E-04	2.87E-05	1.61E-05	1.25E-05	2.65E-05
Thyroid	1.69E-07	1.56E-06	2.18E-07	1.81E-06	2.54E-08	3.80E-06	5.93E-07	4.16E-06	5.72E-08	9.98E-08	1.32E-07	3.42E-07
Trunk	5.65E-09	6.95E-08	7.42E-09	8.73E-08	2.24E-10	1.68E-07	2.53E-08	1.86E-07	1.28E-09	2.34E-09	3.40E-09	1.35E-08
White Matter	6.59E-06	2.28E-04	1.20E-05	6.62E-05	8.31E-06	1.15E-04	4.76E-05	1.54E-04	2.83E-05	1.55E-05	1.18E-05	2.55E-05

Table B.16: S values for the 1-year-old Phantom for Sources Located in the Caudate Nuclei.

Targets	S values (mGy $MBq^{-1}s^{-1}$)											
	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	1.06E-04	1.26E-04	1.72E-04	8.02E-05	1.32E-04	7.20E-04	2.77E-04	2.94E-05	3.35E-05	1.94E-04	3.02E-04	4.82E-05
Caud. Nucl.	9.60E-03	1.17E-02	1.60E-02	6.67E-03	1.48E-02	2.58E-02	2.24E-02	3.13E-03	3.99E-03	1.17E-02	2.30E-02	6.16E-03
Cerebellum	8.17E-06	8.18E-06	8.20E-06	8.19E-06	2.65E-08	8.98E-06	8.13E-06	1.51E-06	9.44E-07	1.89E-05	8.77E-06	2.19E-08
Cereb. Cort.	1.58E-05	1.59E-05	1.59E-05	1.59E-05	5.41E-08	2.36E-05	1.59E-05	2.93E-06	1.83E-06	3.62E-05	1.73E-05	4.22E-08
Cranium	1.11E-05	1.11E-05	1.11E-05	1.11E-05	6.67E-08	1.27E-05	1.11E-05	2.05E-06	1.73E-06	2.54E-05	1.20E-05	3.61E-08
Eyes	1.20E-05	1.21E-05	1.21E-05	1.21E-05	4.03E-08	1.33E-05	1.20E-05	2.23E-06	1.35E-06	2.79E-05	1.29E-05	3.11E-08
Lent. Nucl.	2.28E-04	3.01E-04	5.41E-04	1.62E-04	3.86E-04	5.94E-03	1.40E-03	4.02E-05	2.69E-05	9.16E-04	1.64E-03	4.55E-05
Mandible	5.08E-06	5.09E-06	5.10E-06	5.09E-06	2.13E-08	5.66E-06	5.06E-06	9.40E-07	7.72E-07	1.18E-05	5.47E-06	1.46E-08
Other Tissues	4.73E-06	4.73E-06	4.75E-06	4.74E-06	1.37E-08	5.22E-06	4.70E-06	8.76E-07	5.36E-07	1.09E-05	5.08E-06	1.21E-08
Skin	5.74E-06	5.75E-06	5.76E-06	5.76E-06	1.54E-08	6.32E-06	5.71E-06	1.06E-06	6.09E-07	1.29E-05	6.15E-06	1.49E-08
Spinal Col.	2.25E-06	2.25E-06	2.26E-06	2.25E-06	9.26E-09	2.49E-06	2.24E-06	4.19E-07	3.25E-07	5.36E-06	2.44E-06	5.89E-09
Spinal Skel.	2.76E-06	2.76E-06	2.77E-06	2.76E-06	1.20E-08	3.08E-06	2.75E-06	5.10E-07	4.78E-07	6.11E-06	2.96E-06	8.28E-09
Thalami	8.30E-05	9.07E-05	1.27E-04	7.78E-05	4.59E-05	2.40E-03	3.38E-04	1.48E-05	8.94E-06	3.18E-04	4.25E-04	2.06E-06
Thyroid	1.45E-06	1.46E-06	1.46E-06	1.46E-06	4.39E-09	1.63E-06	1.44E-06	2.73E-07	1.80E-07	4.28E-06	1.61E-06	4.86E-09
Trunk	7.63E-08	7.64E-08	7.65E-08	7.64E-08	1.65E-10	8.54E-08	7.58E-08	1.43E-08	5.83E-09	2.31E-07	8.33E-08	1.90E-10
White Matter	5.13E-05	5.87E-05	8.39E-05	4.47E-05	3.98E-05	8.66E-04	1.80E-04	9.23E-06	5.92E-06	1.64E-04	2.13E-04	4.55E-06

Targets	S values (mGy $MBq^{-1}s^{-1}$)											
	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	7.08E-06	2.31E-04	1.29E-05	6.96E-05	8.88E-06	1.22E-04	4.88E-05	1.61E-04	2.86E-05	1.58E-05	1.23E-05	2.63E-05
Caud. Nucl.	4.60E-04	1.81E-02	8.39E-04	4.48E-03	6.13E-04	8.05E-03	4.96E-03	1.19E-02	3.48E-03	1.77E-03	1.19E-03	2.61E-03
Cerebellum	1.04E-06	7.54E-06	1.53E-06	8.09E-06	5.69E-07	1.66E-05	3.05E-06	1.71E-05	5.50E-07	7.20E-07	9.22E-07	1.92E-06
Cereb. Cort.	2.01E-06	1.48E-05	3.29E-06	1.57E-05	1.66E-06	3.20E-05	5.94E-06	3.29E-05	1.24E-06	1.41E-06	1.80E-06	3.74E-06
Cranium	2.05E-06	1.06E-05	4.02E-06	1.19E-05	3.25E-06	2.24E-05	4.42E-06	2.30E-05	2.27E-06	2.48E-06	2.91E-06	3.02E-06
Eyes	1.45E-06	1.10E-05	1.94E-06	1.17E-05	3.73E-07	2.44E-05	4.49E-06	2.51E-05	5.41E-07	8.29E-07	1.11E-06	2.82E-06
Lent. Nucl.	1.61E-05	1.19E-03	3.31E-05	2.51E-04	2.58E-05	3.23E-04	7.05E-05	4.89E-04	1.76E-05	1.44E-05	1.69E-05	3.29E-05
Mandible	9.19E-07	4.70E-06	1.21E-06	5.04E-06	4.23E-07	1.03E-05	1.99E-06	1.06E-05	5.38E-07	8.27E-07	1.01E-06	1.35E-06
Other Tissues	5.85E-07	4.35E-06	8.04E-07	4.62E-06	2.07E-07	9.62E-06	1.76E-06	9.92E-06	2.50E-07	3.62E-07	4.74E-07	1.10E-06
Skin	6.49E-07	5.27E-06	9.21E-07	5.51E-06	2.44E-07	1.15E-05	2.11E-06	1.18E-05	2.73E-07	3.80E-07	5.05E-07	1.30E-06
Spinal Col.	3.52E-07	2.08E-06	4.48E-07	2.31E-06	7.16E-08	4.90E-06	9.15E-07	5.20E-06	1.28E-07	2.13E-07	2.81E-07	6.22E-07
Spinal Skel.	5.79E-07	2.55E-06	7.17E-07	2.66E-06	2.12E-07	5.54E-06	1.12E-06	5.63E-06	3.26E-07	5.40E-07	6.52E-07	7.96E-07
Thalami	9.78E-06	3.00E-04	1.91E-05	9.50E-05	1.39E-05	1.58E-04	2.95E-05	1.84E-04	7.38E-06	7.45E-06	9.24E-06	1.80E-05
Thyroid	1.96E-07	1.36E-06	2.47E-07	1.71E-06	3.17E-08	3.59E-06	5.69E-07	4.04E-06	6.64E-08	1.12E-07	1.49E-07	3.58E-07
Trunk	6.14E-09	7.08E-08	7.95E-09	8.76E-08	2.74E-10	1.71E-07	2.60E-08	1.88E-07	1.45E-09	2.64E-09	3.79E-09	1.42E-08
White Matter	5.24E-06	1.56E-04	9.88E-06	5.42E-05	6.73E-06	8.96E-05	1.77E-05	1.08E-04	4.30E-06	4.04E-06	4.98E-06	9.99E-06

Table B.17: S values for the 1-year-old Phantom for Sources Located in the Cerebellum.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	9.61E-05	1.15E-04	1.59E-04	7.13E-05	1.28E-04	6.02E-04	2.54E-04	2.77E-05	3.23E-05	1.67E-04	2.75E-04	4.78E-05
Caud. Nucl.	8.29E-06	8.30E-06	8.33E-06	8.31E-06	2.63E-08	9.09E-06	8.25E-06	1.53E-06	9.74E-07	1.92E-05	8.88E-06	2.18E-08
Cerebellum	8.29E-04	1.01E-03	1.42E-03	5.87E-04	1.25E-03	4.82E-03	2.27E-03	2.53E-04	3.10E-04	1.31E-03	2.43E-03	4.75E-04
Cereb. Cort.	1.91E-05	2.10E-05	2.75E-05	1.75E-05	1.01E-05	2.56E-04	5.31E-05	3.48E-06	2.15E-06	5.70E-05	6.29E-05	1.17E-06
Cranium	1.99E-05	2.38E-05	3.76E-05	1.69E-05	1.98E-05	3.11E-04	8.42E-05	3.38E-06	2.47E-06	7.04E-05	9.75E-05	1.28E-06
Eyes	2.06E-06	2.06E-06	2.06E-06	2.06E-06	2.12E-09	2.24E-06	2.04E-06	3.82E-07	2.09E-07	4.92E-06	2.21E-06	4.90E-09
Lent. Nucl.	8.55E-06	8.56E-06	8.58E-06	8.57E-06	2.57E-08	9.53E-06	8.52E-06	1.58E-06	1.02E-06	1.94E-05	9.18E-06	2.22E-08
Mandible	2.50E-06	2.50E-06	2.51E-06	2.51E-06	9.49E-09	2.78E-06	2.49E-06	4.63E-07	3.49E-07	5.97E-06	2.69E-06	6.84E-09
Other Tissues	5.92E-06	5.93E-06	6.04E-06	5.93E-06	1.07E-07	3.37E-05	7.55E-06	1.10E-06	6.35E-07	1.48E-05	8.87E-06	1.54E-08
Skin	6.93E-06	6.95E-06	7.31E-06	6.94E-06	3.38E-07	5.83E-05	1.11E-05	1.28E-06	7.29E-07	1.81E-05	1.34E-05	1.85E-08
Spinal Col.	7.55E-06	7.56E-06	7.60E-06	7.56E-06	4.20E-08	2.52E-05	8.07E-06	1.40E-06	8.84E-07	1.89E-05	9.17E-06	2.13E-08
Spinal Skel.	8.11E-06	8.12E-06	8.23E-06	8.12E-06	1.11E-07	3.20E-05	9.43E-06	1.50E-06	1.17E-06	1.95E-05	1.08E-05	2.44E-08
Thalami	1.33E-05	1.34E-05	1.34E-05	1.34E-05	3.79E-08	1.47E-05	1.33E-05	2.47E-06	1.60E-06	2.97E-05	1.43E-05	3.42E-08
Thyroid	1.78E-06	1.79E-06	1.79E-06	1.79E-06	1.37E-09	2.00E-06	1.77E-06	3.33E-07	1.78E-07	4.67E-06	1.95E-06	4.09E-09
Trunk	9.99E-08	1.00E-07	1.00E-07	1.00E-07	1.76E-10	1.12E-07	9.93E-08	1.87E-08	7.21E-09	3.09E-07	1.09E-07	2.43E-10
White Matter	1.17E-05	1.17E-05	1.17E-05	1.17E-05	3.97E-08	3.26E-05	1.20E-05	2.16E-06	1.33E-06	2.71E-05	1.34E-05	3.13E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.92E-06	2.10E-04	1.08E-05	5.97E-05	7.45E-06	1.04E-04	4.53E-05	1.41E-04	2.77E-05	1.49E-05	1.12E-05	2.42E-05
Caud. Nucl.	1.07E-06	7.64E-06	1.57E-06	8.15E-06	5.79E-07	1.66E-05	3.11E-06	1.69E-05	5.65E-07	7.51E-07	9.59E-07	1.98E-06
Cerebellum	4.39E-05	1.86E-03	8.18E-05	4.61E-04	6.01E-05	7.81E-04	4.06E-04	1.13E-03	2.68E-04	1.39E-04	9.80E-05	2.13E-04
Cereb. Cort.	2.03E-06	4.67E-05	3.63E-06	1.99E-05	2.21E-06	3.53E-05	6.75E-06	4.05E-05	1.47E-06	1.48E-06	1.85E-06	3.93E-06
Cranium	2.76E-06	7.28E-05	6.99E-06	2.47E-05	7.22E-06	3.52E-05	6.84E-06	4.47E-05	3.77E-06	3.49E-06	4.01E-06	4.18E-06
Eyes	2.22E-07	1.88E-06	2.77E-07	2.05E-06	1.22E-08	4.30E-06	7.49E-07	4.51E-06	5.41E-08	9.76E-08	1.39E-07	4.54E-07
Lent. Nucl.	1.14E-06	7.88E-06	1.64E-06	8.31E-06	5.92E-07	1.72E-05	3.21E-06	1.76E-05	5.90E-07	7.85E-07	1.01E-06	2.04E-06
Mandible	4.12E-07	2.30E-06	4.96E-07	2.48E-06	9.73E-08	5.11E-06	9.55E-07	5.29E-06	1.93E-07	3.38E-07	4.17E-07	6.31E-07
Other Tissues	6.89E-07	6.99E-06	1.04E-06	5.91E-06	3.81E-07	1.21E-05	2.18E-06	1.26E-05	3.38E-07	4.30E-07	5.63E-07	1.34E-06
Skin	7.86E-07	1.02E-05	1.24E-06	6.95E-06	5.30E-07	1.40E-05	2.54E-06	1.46E-05	4.09E-07	4.77E-07	6.28E-07	1.56E-06
Spinal Col.	9.60E-07	7.53E-06	1.36E-06	7.73E-06	3.93E-07	1.60E-05	2.86E-06	1.69E-05	4.11E-07	5.58E-07	7.42E-07	1.81E-06
Spinal Skel.	1.38E-06	8.80E-06	2.08E-06	8.24E-06	1.07E-06	1.65E-05	3.14E-06	1.71E-05	1.02E-06	1.39E-06	1.67E-06	2.09E-06
Thalami	1.74E-06	1.23E-05	2.72E-06	1.30E-05	1.21E-06	2.68E-05	5.05E-06	2.73E-05	1.02E-06	1.25E-06	1.59E-06	3.22E-06
Thyroid	1.94E-07	1.65E-06	2.41E-07	1.90E-06	1.65E-08	4.05E-06	6.47E-07	4.40E-06	5.64E-08	1.02E-07	1.38E-07	3.82E-07
Trunk	7.41E-09	9.28E-08	9.78E-09	1.16E-07	1.47E-10	2.23E-07	3.39E-08	2.47E-07	1.47E-09	2.71E-09	4.10E-09	1.82E-08
White Matter	1.46E-06	1.12E-05	2.37E-06	1.16E-05	1.17E-06	2.36E-05	4.36E-06	2.43E-05	8.77E-07	1.01E-06	1.29E-06	2.73E-06

Table B.18: S values for the 1-year-old Phantom for Sources Located in the Cerebral Cortex.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	9.46E-05	1.13E-04	1.56E-04	7.02E-05	1.26E-04	5.51E-04	2.45E-04	2.74E-05	3.22E-05	1.61E-04	2.64E-04	4.75E-05
Caud. Nucl.	1.58E-05	1.58E-05	1.58E-05	1.58E-05	5.64E-08	2.35E-05	1.58E-05	2.92E-06	1.83E-06	3.55E-05	1.72E-05	4.18E-08
Cerebellum	1.91E-05	2.09E-05	2.73E-05	1.75E-05	9.98E-06	2.56E-04	5.27E-05	3.46E-06	2.14E-06	5.68E-05	6.24E-05	1.13E-06
Cereb. Cort.	1.94E-04	2.35E-04	3.26E-04	1.39E-04	2.84E-04	9.05E-04	4.97E-04	5.94E-05	7.28E-05	2.92E-04	5.27E-04	1.11E-04
Cranium	2.33E-05	2.94E-05	5.07E-05	1.86E-05	3.09E-05	4.14E-04	1.22E-04	3.79E-06	2.70E-06	9.00E-05	1.40E-04	2.04E-06
Eyes	8.96E-06	8.97E-06	8.99E-06	8.98E-06	1.81E-08	2.17E-05	9.13E-06	1.66E-06	8.88E-07	2.06E-05	1.01E-05	2.11E-08
Lent. Nucl.	1.61E-05	1.61E-05	1.62E-05	1.62E-05	9.07E-08	8.13E-05	1.83E-05	2.99E-06	1.84E-06	3.84E-05	2.13E-05	4.33E-08
Mandible	3.79E-06	3.80E-06	3.84E-06	3.80E-06	4.53E-08	1.20E-05	4.21E-06	7.03E-07	5.33E-07	9.23E-06	4.75E-06	1.11E-08
Other Tissues	4.43E-06	4.44E-06	4.53E-06	4.44E-06	9.12E-08	2.50E-05	5.69E-06	8.20E-07	4.80E-07	1.12E-05	6.68E-06	1.16E-08
Skin	7.87E-06	7.93E-06	9.26E-06	7.87E-06	1.23E-06	1.20E-04	2.11E-05	1.45E-06	8.28E-07	2.49E-05	2.61E-05	2.33E-08
Spinal Col.	4.36E-06	4.37E-06	4.43E-06	4.37E-06	6.26E-08	2.29E-05	5.44E-06	8.06E-07	4.37E-07	1.02E-05	6.32E-06	1.13E-08
Spinal Skel.	3.74E-06	3.74E-06	3.78E-06	3.74E-06	4.29E-08	1.55E-05	4.30E-06	6.92E-07	5.65E-07	9.04E-06	4.94E-06	1.10E-08
Thalami	1.64E-05	1.65E-05	1.65E-05	1.65E-05	5.68E-08	3.68E-05	1.67E-05	3.04E-06	1.87E-06	3.75E-05	1.84E-05	4.49E-08
Thyroid	1.47E-06	1.47E-06	1.47E-06	1.47E-06	4.80E-09	1.61E-06	1.46E-06	2.75E-07	1.34E-07	3.95E-06	1.60E-06	3.37E-09
Trunk	6.77E-08	6.78E-08	6.79E-08	6.78E-08	1.35E-10	7.58E-08	6.74E-08	1.27E-08	4.95E-09	2.08E-07	7.40E-08	1.60E-10
White Matter	2.35E-05	2.60E-05	3.42E-05	2.14E-05	1.30E-05	3.27E-04	6.76E-05	4.27E-06	2.66E-06	7.09E-05	8.02E-05	1.47E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.78E-06	2.03E-04	1.05E-05	5.80E-05	7.19E-06	1.02E-04	4.48E-05	1.38E-04	2.75E-05	1.48E-05	1.10E-05	2.39E-05
Caud. Nucl.	2.02E-06	1.47E-05	3.29E-06	1.56E-05	1.66E-06	3.20E-05	5.92E-06	3.28E-05	1.26E-06	1.43E-06	1.82E-06	3.73E-06
Cerebellum	2.03E-06	4.63E-05	3.62E-06	1.99E-05	2.20E-06	3.51E-05	6.73E-06	4.01E-05	1.47E-06	1.48E-06	1.85E-06	3.92E-06
Cereb. Cort.	1.04E-05	4.07E-04	1.90E-05	1.06E-04	1.35E-05	1.85E-04	9.55E-05	2.63E-04	6.29E-05	3.27E-05	2.31E-05	5.03E-05
Cranium	2.90E-06	1.04E-04	7.56E-06	2.96E-05	7.98E-06	3.89E-05	7.56E-06	5.32E-05	4.03E-06	3.74E-06	4.27E-06	4.42E-06
Eyes	9.61E-07	8.45E-06	1.31E-06	8.57E-06	2.73E-07	1.78E-05	3.21E-06	1.82E-05	3.59E-07	5.23E-07	7.06E-07	1.93E-06
Lent. Nucl.	2.03E-06	1.72E-05	3.38E-06	1.62E-05	1.78E-06	3.31E-05	6.03E-06	3.42E-05	1.28E-06	1.44E-06	1.83E-06	3.76E-06
Mandible	6.25E-07	3.92E-06	8.67E-07	3.85E-06	3.42E-07	7.81E-06	1.46E-06	8.12E-06	3.78E-07	5.55E-07	6.77E-07	9.68E-07
Other Tissues	5.20E-07	5.26E-06	7.65E-07	4.45E-06	2.59E-07	9.07E-06	1.63E-06	9.45E-06	2.43E-07	3.18E-07	4.18E-07	1.01E-06
Skin	8.90E-07	1.89E-05	1.44E-06	8.31E-06	6.44E-07	1.59E-05	2.89E-06	1.71E-05	4.67E-07	5.30E-07	7.01E-07	1.78E-06
Spinal Col.	4.60E-07	5.00E-06	6.62E-07	4.09E-06	1.75E-07	8.36E-06	1.57E-06	8.43E-06	1.83E-07	2.56E-07	3.45E-07	9.62E-07
Spinal Skel.	6.67E-07	4.02E-06	9.68E-07	3.81E-06	4.56E-07	7.60E-06	1.47E-06	7.86E-06	4.58E-07	6.44E-07	7.76E-07	9.97E-07
Thalami	2.08E-06	1.56E-05	3.38E-06	1.63E-05	1.70E-06	3.32E-05	6.11E-06	3.41E-05	1.27E-06	1.45E-06	1.85E-06	3.82E-06
Thyroid	1.53E-07	1.36E-06	1.89E-07	1.61E-06	1.95E-08	3.28E-06	5.10E-07	3.59E-06	5.15E-08	8.91E-08	1.18E-07	2.88E-07
Trunk	5.10E-09	6.29E-08	6.75E-09	7.82E-08	1.95E-10	1.51E-07	2.30E-08	1.67E-07	1.12E-09	2.04E-09	3.01E-09	1.24E-08
White Matter	2.52E-06	5.93E-05	4.51E-06	2.45E-05	2.78E-06	4.32E-05	8.29E-06	4.97E-05	1.84E-06	1.85E-06	2.31E-06	4.82E-06

Table B.19: S values for the 1-year-old Phantom for Sources Located in the Cranial CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	4.00E-05	4.95E-05	7.22E-05	2.82E-05	5.22E-05	3.23E-04	1.23E-04	8.32E-06	6.33E-06	8.97E-05	1.35E-04	1.26E-05
Caud. Nucl.	1.17E-05	1.17E-05	1.17E-05	1.17E-05	4.26E-08	1.36E-05	1.16E-05	2.17E-06	1.35E-06	2.70E-05	1.26E-05	3.25E-08
Cerebellum	4.96E-05	6.26E-05	9.33E-05	3.36E-05	7.08E-05	4.20E-04	1.62E-04	1.04E-05	7.98E-06	1.11E-04	1.78E-04	1.69E-05
Cereb. Cort.	6.76E-05	8.72E-05	1.34E-04	4.35E-05	1.07E-04	5.51E-04	2.36E-04	1.44E-05	1.14E-05	1.49E-04	2.58E-04	2.57E-05
Cranium	2.04E-04	2.75E-04	4.22E-04	1.15E-04	3.74E-04	9.06E-04	6.35E-04	4.50E-05	3.80E-05	3.43E-04	6.60E-04	9.54E-05
Eyes	9.21E-06	9.22E-06	9.24E-06	9.22E-06	2.21E-08	3.96E-05	9.74E-06	1.70E-06	9.00E-07	2.18E-05	1.12E-05	2.21E-08
Lent. Nucl.	1.22E-05	1.22E-05	1.22E-05	1.22E-05	4.97E-08	3.53E-05	1.25E-05	2.25E-06	1.43E-06	2.88E-05	1.40E-05	3.42E-08
Mandible	4.02E-06	4.07E-06	4.33E-06	4.01E-06	2.95E-07	2.07E-05	5.81E-06	7.42E-07	5.51E-07	1.06E-05	6.72E-06	1.42E-08
Other Tissues	5.26E-06	5.39E-06	6.55E-06	5.21E-06	1.20E-06	5.75E-05	1.37E-05	9.64E-07	5.50E-07	1.66E-05	1.63E-05	2.10E-08
Skin	1.10E-05	1.28E-05	2.69E-05	1.01E-05	1.51E-05	2.20E-04	8.34E-05	1.87E-06	1.01E-06	5.64E-05	9.57E-05	1.44E-07
Spinal Col.	5.09E-06	5.16E-06	5.84E-06	5.08E-06	6.85E-07	4.67E-05	1.12E-05	9.37E-07	5.34E-07	1.45E-05	1.33E-05	1.70E-08
Spinal Skel.	4.63E-06	4.67E-06	5.23E-06	4.61E-06	5.55E-07	3.90E-05	9.18E-06	8.53E-07	6.62E-07	1.31E-05	1.09E-05	1.62E-08
Thalami	1.28E-05	1.28E-05	1.28E-05	1.28E-05	4.35E-08	1.66E-05	1.28E-05	2.36E-06	1.41E-06	2.82E-05	1.38E-05	3.43E-08
Thyroid	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.41E-09	1.69E-06	1.43E-06	2.71E-07	1.80E-07	4.08E-06	1.60E-06	3.22E-09
Trunk	6.78E-08	6.78E-08	6.80E-08	6.79E-08	1.66E-10	7.59E-08	6.75E-08	1.27E-08	5.07E-09	2.03E-07	7.40E-08	1.72E-10
White Matter	1.38E-05	1.38E-05	1.39E-05	1.39E-05	5.24E-08	1.12E-04	1.60E-05	2.56E-06	1.53E-06	3.39E-05	1.94E-05	3.75E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	2.18E-06	1.03E-04	3.92E-06	3.14E-05	2.25E-06	5.00E-05	1.37E-05	6.87E-05	3.46E-06	1.90E-06	2.22E-06	5.53E-06
Caud. Nucl.	1.49E-06	1.08E-05	2.36E-06	1.17E-05	1.09E-06	2.37E-05	4.37E-06	2.45E-05	8.73E-07	1.01E-06	1.30E-06	2.74E-06
Cerebellum	2.40E-06	1.35E-04	4.42E-06	3.81E-05	2.64E-06	5.87E-05	1.69E-05	8.39E-05	4.31E-06	2.22E-06	2.53E-06	6.38E-06
Cereb. Cort.	2.73E-06	1.96E-04	5.11E-06	5.01E-05	3.07E-06	7.35E-05	2.29E-05	1.11E-04	6.04E-06	2.73E-06	3.03E-06	8.04E-06
Cranium	5.80E-06	5.16E-04	1.51E-05	1.31E-04	1.44E-05	1.77E-04	6.83E-05	2.99E-04	2.27E-05	9.55E-06	9.83E-06	1.99E-05
Eyes	9.60E-07	9.08E-06	1.32E-06	8.91E-06	2.76E-07	1.85E-05	3.30E-06	1.91E-05	3.66E-07	5.48E-07	7.33E-07	1.98E-06
Lent. Nucl.	1.58E-06	1.17E-05	2.50E-06	1.22E-05	1.17E-06	2.49E-05	4.59E-06	2.57E-05	9.06E-07	1.06E-06	1.37E-06	2.90E-06
Mandible	6.45E-07	5.31E-06	9.21E-07	4.20E-06	3.96E-07	8.21E-06	1.53E-06	8.66E-06	4.07E-07	5.80E-07	7.06E-07	1.01E-06
Other Tissues	5.97E-07	1.21E-05	9.03E-07	5.70E-06	3.39E-07	1.07E-05	1.91E-06	1.17E-05	2.90E-07	3.66E-07	4.81E-07	1.17E-06
Skin	1.08E-06	7.06E-05	1.80E-06	1.54E-05	8.65E-07	2.08E-05	3.66E-06	2.85E-05	5.84E-07	6.51E-07	8.58E-07	2.21E-06
Spinal Col.	5.69E-07	9.95E-06	8.10E-07	5.12E-06	2.16E-07	9.94E-06	1.86E-06	1.05E-05	2.22E-07	3.03E-07	4.12E-07	1.15E-06
Spinal Skel.	7.77E-07	8.28E-06	1.18E-06	4.92E-06	6.14E-07	9.39E-06	1.79E-06	9.98E-06	5.62E-07	7.58E-07	9.12E-07	1.19E-06
Thalami	1.55E-06	1.19E-05	2.43E-06	1.24E-05	1.08E-06	2.56E-05	4.71E-06	2.61E-05	8.81E-07	1.05E-06	1.35E-06	2.92E-06
Thyroid	1.85E-07	1.35E-06	2.43E-07	1.67E-06	2.82E-08	3.58E-06	5.78E-07	4.01E-06	5.76E-08	9.92E-08	1.35E-07	3.71E-07
Trunk	5.22E-09	6.30E-08	6.90E-09	7.75E-08	2.10E-10	1.50E-07	2.31E-08	1.65E-07	1.15E-09	2.10E-09	3.09E-09	1.26E-08
White Matter	1.68E-06	1.52E-05	2.84E-06	1.39E-05	1.52E-06	2.81E-05	5.14E-06	2.89E-05	1.03E-06	1.13E-06	1.46E-06	3.19E-06

Table B.20: S values for the 1-year-old Phantom for Sources Located in the Cranium.

Targets	S values (mGy $MBq^{-1}s^{-1}$)											
	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	1.55E-05	3.13E-09	1.10E-05	4.39E-07	3.09E-05	1.80E-06	8.88E-07	6.03E-06	2.04E-06	3.17E-06	2.16E-05	9.69E-08
Caud. Nucl.	4.13E-08	5.97E-10	3.20E-08	4.44E-09	7.89E-08	1.36E-06	5.02E-07	4.17E-06	9.01E-07	2.55E-07	6.74E-07	7.11E-08
Cerebellum	2.02E-05	3.58E-09	1.44E-05	5.41E-07	4.09E-05	1.94E-06	1.02E-06	6.52E-06	2.35E-06	3.99E-06	2.82E-05	1.05E-07
Cereb. Cort.	3.18E-05	5.91E-09	2.27E-05	9.09E-07	6.34E-05	2.04E-06	1.09E-06	7.35E-06	3.08E-06	6.25E-06	4.37E-05	1.12E-07
Cranium	6.78E-04	1.11E-04	6.02E-04	2.65E-04	7.58E-04	2.74E-05	1.73E-05	2.72E-04	3.70E-04	4.26E-04	7.16E-04	6.73E-03
Eyes	2.75E-08	4.03E-10	2.10E-08	2.78E-09	1.03E-07	9.58E-07	1.81E-07	3.14E-06	4.81E-07	1.63E-07	4.96E-07	5.20E-08
Lent. Nucl.	4.53E-08	3.20E-10	3.50E-08	3.73E-09	9.76E-08	1.50E-06	6.00E-07	4.52E-06	9.97E-07	2.78E-07	7.28E-07	7.84E-08
Mandible	1.10E-06	6.48E-09	8.11E-07	6.62E-08	2.08E-06	6.62E-07	2.59E-07	1.66E-06	6.38E-07	3.94E-07	1.70E-06	3.20E-08
Other Tissues	6.74E-06	4.72E-08	5.06E-06	4.80E-07	1.17E-05	6.26E-07	2.15E-07	2.45E-06	1.08E-06	1.84E-06	8.70E-06	3.66E-08
Skin	8.92E-05	9.38E-07	7.15E-05	9.92E-06	1.22E-04	1.38E-06	5.79E-07	1.36E-05	1.50E-05	3.05E-05	1.00E-04	1.30E-07
Spinal Col.	4.48E-06	3.15E-08	3.35E-06	3.09E-07	8.29E-06	5.77E-07	1.38E-07	2.15E-06	7.71E-07	1.23E-06	6.03E-06	3.20E-08
Spinal Skel.	3.46E-06	2.15E-08	2.57E-06	2.30E-07	6.35E-06	8.05E-07	4.17E-07	2.04E-06	1.08E-06	1.02E-06	4.76E-06	3.93E-08
Thalami	4.55E-08	6.94E-10	3.50E-08	4.72E-09	8.23E-08	1.43E-06	5.47E-07	4.29E-06	9.78E-07	2.74E-07	7.08E-07	7.54E-08
Thyroid	3.33E-09	1.04E-09	2.78E-09	6.10E-10	6.53E-09	1.63E-07	2.03E-08	6.17E-07	8.34E-08	2.87E-08	9.69E-08	8.76E-09
Trunk	1.58E-10	5.86E-13	1.20E-10	9.45E-12	3.34E-10	5.18E-09	1.55E-10	2.28E-08	1.84E-09	8.05E-10	3.55E-09	2.93E-10
White Matter	5.07E-08	5.81E-10	3.90E-08	4.47E-09	2.01E-07	1.57E-06	7.04E-07	4.84E-06	1.07E-06	2.93E-07	7.92E-07	8.38E-08

Table B.21: S values for the 1-year-old Phantom for Sources Located in the Lateral Ventricles.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	1.08E-04	1.27E-04	1.73E-04	8.21E-05	1.32E-04	7.22E-04	2.79E-04	2.97E-05	3.37E-05	1.99E-04	3.04E-04	4.82E-05
Caud. Nucl.	7.92E-05	8.05E-05	9.48E-05	7.88E-05	1.43E-05	2.74E-03	2.66E-04	1.46E-05	8.96E-06	2.97E-04	3.59E-04	2.92E-07
Cerebellum	1.37E-05	1.37E-05	1.37E-05	1.37E-05	4.73E-08	1.74E-05	1.37E-05	2.53E-06	1.58E-06	3.13E-05	1.48E-05	3.71E-08
Cereb. Cort.	1.93E-05	1.94E-05	1.97E-05	1.94E-05	3.30E-07	1.35E-04	2.46E-05	3.58E-06	2.21E-06	4.79E-05	2.94E-05	5.35E-08
Cranium	1.08E-05	1.08E-05	1.09E-05	1.08E-05	6.18E-08	1.21E-05	1.08E-05	2.00E-06	1.67E-06	2.47E-05	1.17E-05	3.42E-08
Eyes	7.84E-06	7.85E-06	7.87E-06	7.85E-06	2.10E-08	8.71E-06	7.77E-06	1.45E-06	8.37E-07	1.78E-05	8.35E-06	1.92E-08
Lent. Nucl.	5.35E-05	5.44E-05	6.03E-05	5.32E-05	6.46E-06	8.10E-04	1.10E-04	9.85E-06	6.17E-06	1.56E-04	1.38E-04	2.04E-07
Mandible	3.86E-06	3.86E-06	3.87E-06	3.86E-06	1.48E-08	4.31E-06	3.84E-06	7.14E-07	5.89E-07	8.96E-06	4.15E-06	1.06E-08
Other Tissues	4.15E-06	4.15E-06	4.16E-06	4.16E-06	1.23E-08	4.58E-06	4.12E-06	7.68E-07	4.71E-07	9.64E-06	4.45E-06	1.08E-08
Skin	5.53E-06	5.53E-06	5.55E-06	5.54E-06	1.61E-08	6.10E-06	5.49E-06	1.02E-06	6.01E-07	1.27E-05	5.93E-06	1.45E-08
Spinal Col.	3.37E-06	3.38E-06	3.39E-06	3.38E-06	1.08E-08	3.64E-06	3.37E-06	6.26E-07	3.97E-07	7.90E-06	3.64E-06	8.35E-09
Spinal Skel.	3.33E-06	3.33E-06	3.35E-06	3.33E-06	1.61E-08	3.72E-06	3.32E-06	6.16E-07	5.62E-07	7.63E-06	3.58E-06	9.64E-09
Thalami	7.25E-05	7.42E-05	8.42E-05	7.16E-05	1.16E-05	1.43E-03	1.67E-04	1.33E-05	8.10E-06	2.21E-04	2.15E-04	3.85E-07
Thyroid	1.61E-06	1.61E-06	1.62E-06	1.61E-06	7.23E-09	1.75E-06	1.59E-06	2.98E-07	1.40E-07	4.36E-06	1.76E-06	4.52E-09
Trunk	8.06E-08	8.07E-08	8.08E-08	8.08E-08	1.51E-10	9.05E-08	8.02E-08	1.52E-08	6.16E-09	2.60E-07	8.85E-08	1.96E-10
White Matter	5.17E-05	5.97E-05	8.63E-05	4.46E-05	4.23E-05	8.22E-04	1.85E-04	9.31E-06	6.02E-06	1.65E-04	2.17E-04	4.90E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	7.33E-06	2.33E-04	1.34E-05	7.15E-05	9.16E-06	1.26E-04	4.95E-05	1.65E-04	2.88E-05	1.60E-05	1.25E-05	2.67E-05
Caud. Nucl.	1.02E-05	2.44E-04	2.02E-05	8.89E-05	1.50E-05	1.62E-04	2.97E-05	1.76E-04	7.80E-06	7.57E-06	9.47E-06	1.86E-05
Cerebellum	1.73E-06	1.27E-05	2.78E-06	1.36E-05	1.33E-06	2.77E-05	5.12E-06	2.84E-05	1.05E-06	1.23E-06	1.57E-06	3.22E-06
Cereb. Cort.	2.45E-06	2.30E-05	4.17E-06	1.95E-05	2.32E-06	3.92E-05	7.25E-06	4.05E-05	1.59E-06	1.73E-06	2.21E-06	4.55E-06
Cranium	1.97E-06	1.03E-05	3.69E-06	1.14E-05	2.83E-06	2.18E-05	4.28E-06	2.24E-05	2.11E-06	2.40E-06	2.81E-06	2.91E-06
Eyes	8.84E-07	7.15E-06	1.17E-06	7.47E-06	1.75E-07	1.54E-05	2.88E-06	1.57E-05	3.04E-07	4.97E-07	6.67E-07	1.79E-06
Lent. Nucl.	6.93E-06	1.01E-04	1.30E-05	5.69E-05	8.87E-06	1.08E-04	2.01E-05	1.14E-04	5.10E-06	5.04E-06	6.36E-06	1.26E-05
Mandible	7.04E-07	3.56E-06	8.82E-07	3.82E-06	2.46E-07	7.87E-06	1.51E-06	8.12E-06	3.77E-07	6.17E-07	7.53E-07	1.03E-06
Other Tissues	5.13E-07	3.81E-06	6.97E-07	4.07E-06	1.64E-07	8.45E-06	1.54E-06	8.72E-06	2.14E-07	3.18E-07	4.17E-07	9.69E-07
Skin	6.49E-07	5.08E-06	9.18E-07	5.39E-06	2.57E-07	1.13E-05	2.04E-06	1.17E-05	2.84E-07	3.93E-07	5.18E-07	1.26E-06
Spinal Col.	4.43E-07	3.11E-06	5.72E-07	3.35E-06	1.08E-07	6.97E-06	1.26E-06	7.26E-06	1.64E-07	2.49E-07	3.32E-07	7.96E-07
Spinal Skel.	6.76E-07	3.08E-06	8.61E-07	3.28E-06	2.80E-07	6.74E-06	1.34E-06	6.90E-06	3.92E-07	6.25E-07	7.57E-07	9.45E-07
Thalami	9.14E-06	1.54E-04	1.77E-05	7.76E-05	1.26E-05	1.44E-04	2.68E-05	1.54E-04	6.88E-06	6.66E-06	8.38E-06	1.67E-05
Thyroid	1.53E-07	1.49E-06	1.97E-07	1.69E-06	1.96E-08	3.73E-06	5.65E-07	4.06E-06	4.68E-08	7.90E-08	1.08E-07	3.15E-07
Trunk	6.44E-09	7.53E-08	8.38E-09	9.65E-08	2.46E-10	1.86E-07	2.77E-08	2.08E-07	1.46E-09	2.67E-09	3.88E-09	1.50E-08
White Matter	5.24E-06	1.60E-04	9.79E-06	5.46E-05	6.58E-06	8.96E-05	1.78E-05	1.09E-04	4.32E-06	4.07E-06	5.01E-06	9.97E-06

Table B.22: S values for the 1-year-old Phantom for Sources Located in the Lentiform Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	1.04E-04	1.24E-04	1.70E-04	7.90E-05	1.32E-04	7.15E-04	2.76E-04	2.92E-05	3.34E-05	1.92E-04	3.01E-04	4.82E-05
Caud. Nucl.	2.27E-04	3.00E-04	5.39E-04	1.62E-04	3.84E-04	5.93E-03	1.39E-03	4.01E-05	2.69E-05	9.14E-04	1.63E-03	4.50E-05
Cerebellum	8.64E-06	8.66E-06	8.68E-06	8.66E-06	2.92E-08	9.55E-06	8.60E-06	1.60E-06	1.02E-06	1.98E-05	9.29E-06	2.28E-08
Cereb. Cort.	1.60E-05	1.60E-05	1.61E-05	1.61E-05	1.06E-07	8.38E-05	1.82E-05	2.97E-06	1.85E-06	3.83E-05	2.12E-05	4.36E-08
Cranium	1.19E-05	1.19E-05	1.20E-05	1.19E-05	7.38E-08	2.71E-05	1.22E-05	2.21E-06	1.86E-06	2.75E-05	1.34E-05	3.93E-08
Eyes	1.16E-05	1.16E-05	1.16E-05	1.16E-05	2.91E-08	1.29E-05	1.15E-05	2.14E-06	1.27E-06	2.63E-05	1.24E-05	2.80E-08
Lent. Nucl.	5.40E-03	6.60E-03	9.13E-03	3.76E-03	8.35E-03	2.01E-02	1.35E-02	1.73E-03	2.19E-03	7.20E-03	1.41E-02	3.39E-03
Mandible	7.04E-06	7.05E-06	7.07E-06	7.05E-06	3.26E-08	7.84E-06	7.02E-06	1.30E-06	1.08E-06	1.61E-05	7.57E-06	2.05E-08
Other Tissues	6.50E-06	6.51E-06	6.53E-06	6.52E-06	1.99E-08	8.04E-06	6.48E-06	1.20E-06	7.46E-07	1.49E-05	7.02E-06	1.70E-08
Skin	5.51E-06	5.51E-06	5.53E-06	5.52E-06	1.51E-08	6.06E-06	5.48E-06	1.02E-06	5.87E-07	1.25E-05	5.91E-06	1.38E-08
Spinal Col.	3.28E-06	3.28E-06	3.29E-06	3.28E-06	1.04E-08	3.62E-06	3.26E-06	6.07E-07	4.49E-07	7.56E-06	3.54E-06	8.91E-09
Spinal Skel.	3.70E-06	3.71E-06	3.72E-06	3.71E-06	1.72E-08	4.14E-06	3.69E-06	6.84E-07	6.58E-07	8.18E-06	3.97E-06	1.06E-08
Thalami	2.22E-04	2.86E-04	4.94E-04	1.64E-04	3.37E-04	5.69E-03	1.24E-03	3.94E-05	2.62E-05	8.55E-04	1.47E-03	4.03E-05
Thyroid	2.54E-06	2.55E-06	2.55E-06	2.55E-06	9.14E-09	2.92E-06	2.54E-06	4.69E-07	2.54E-07	5.88E-06	2.73E-06	5.78E-09
Trunk	9.76E-08	9.77E-08	9.79E-08	9.78E-08	1.87E-10	1.09E-07	9.71E-08	1.83E-08	7.96E-09	2.93E-07	1.07E-07	2.33E-10
White Matter	4.31E-05	4.84E-05	6.62E-05	3.84E-05	2.82E-05	6.67E-04	1.35E-04	7.80E-06	5.02E-06	1.33E-04	1.60E-04	3.30E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	6.95E-06	2.30E-04	1.27E-05	6.84E-05	8.67E-06	1.19E-04	4.84E-05	1.58E-04	2.85E-05	1.57E-05	1.21E-05	2.60E-05
Caud. Nucl.	1.62E-05	1.18E-03	3.31E-05	2.50E-04	2.57E-05	3.23E-04	7.04E-05	4.88E-04	1.76E-05	1.44E-05	1.69E-05	3.30E-05
Cerebellum	1.12E-06	7.97E-06	1.64E-06	8.49E-06	5.94E-07	1.76E-05	3.25E-06	1.81E-05	5.83E-07	7.68E-07	9.86E-07	2.06E-06
Cereb. Cort.	2.04E-06	1.71E-05	3.39E-06	1.60E-05	1.78E-06	3.24E-05	6.02E-06	3.34E-05	1.27E-06	1.43E-06	1.83E-06	3.79E-06
Cranium	2.22E-06	1.17E-05	4.48E-06	1.28E-05	3.78E-06	2.41E-05	4.76E-06	2.47E-05	2.52E-06	2.67E-06	3.13E-06	3.23E-06
Eyes	1.38E-06	1.06E-05	1.79E-06	1.12E-05	2.68E-07	2.35E-05	4.26E-06	2.42E-05	4.77E-07	7.72E-07	1.04E-06	2.65E-06
Lent. Nucl.	2.64E-04	1.10E-02	4.85E-04	2.65E-03	3.56E-04	4.64E-03	2.76E-03	6.85E-03	1.91E-03	9.73E-04	6.63E-04	1.45E-03
Mandible	1.27E-06	6.53E-06	1.79E-06	7.02E-06	7.84E-07	1.42E-05	2.77E-06	1.46E-05	8.44E-07	1.22E-06	1.47E-06	1.89E-06
Other Tissues	8.16E-07	6.01E-06	1.17E-06	6.38E-06	3.78E-07	1.32E-05	2.43E-06	1.36E-05	3.87E-07	5.23E-07	6.80E-07	1.53E-06
Skin	6.34E-07	5.05E-06	8.74E-07	5.33E-06	2.07E-07	1.12E-05	2.02E-06	1.15E-05	2.54E-07	3.63E-07	4.85E-07	1.24E-06
Spinal Col.	4.97E-07	3.02E-06	6.38E-07	3.22E-06	1.21E-07	6.89E-06	1.30E-06	7.16E-06	1.87E-07	2.91E-07	3.85E-07	8.63E-07
Spinal Skel.	7.93E-07	3.43E-06	1.02E-06	3.60E-06	3.58E-07	7.39E-06	1.52E-06	7.50E-06	4.80E-07	7.57E-07	9.12E-07	1.09E-06
Thalami	1.68E-05	1.06E-03	3.43E-05	2.41E-04	2.64E-05	3.26E-04	7.01E-05	4.70E-04	1.76E-05	1.45E-05	1.71E-05	3.40E-05
Thyroid	2.81E-07	2.33E-06	3.57E-07	2.42E-06	4.78E-08	5.01E-06	9.02E-07	5.11E-06	9.68E-08	1.62E-07	2.15E-07	5.42E-07
Trunk	8.37E-09	9.06E-08	1.08E-08	1.12E-07	4.37E-10	2.17E-07	3.38E-08	2.39E-07	2.03E-09	3.70E-09	5.28E-09	1.89E-08
White Matter	4.61E-06	1.18E-04	8.53E-06	4.51E-05	5.64E-06	7.71E-05	1.51E-05	9.05E-05	3.64E-06	3.50E-06	4.34E-06	8.71E-06

Table B.23: S values for the 1-year-old Phantom for Sources Located in the Spinal CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	4.91E-06	4.92E-06	4.95E-06	4.92E-06	3.74E-08	1.44E-05	5.38E-06	9.09E-07	5.40E-07	1.18E-05	6.04E-06	1.25E-08
Caud. Nucl.	4.09E-06	4.10E-06	4.11E-06	4.10E-06	1.26E-08	4.51E-06	4.08E-06	7.59E-07	4.82E-07	9.49E-06	4.42E-06	9.83E-09
Cerebellum	8.55E-06	8.56E-06	8.65E-06	8.57E-06	8.10E-08	2.82E-05	9.52E-06	1.58E-06	9.37E-07	2.06E-05	1.08E-05	2.24E-08
Cereb. Cort.	4.61E-06	4.62E-06	4.68E-06	4.62E-06	5.51E-08	2.15E-05	5.50E-06	8.55E-07	5.01E-07	1.14E-05	6.38E-06	1.17E-08
Cranium	6.76E-06	7.62E-06	1.03E-05	5.98E-06	4.44E-06	5.46E-05	1.83E-05	1.23E-06	9.70E-07	1.90E-05	2.07E-05	5.50E-07
Eyes	1.97E-06	1.97E-06	1.98E-06	1.97E-06	6.93E-09	2.20E-06	1.96E-06	3.67E-07	1.95E-07	4.91E-06	2.13E-06	5.31E-09
Lent. Nucl.	5.35E-06	5.36E-06	5.38E-06	5.36E-06	2.10E-08	5.89E-06	5.33E-06	9.92E-07	6.19E-07	1.25E-05	5.76E-06	1.34E-08
Mandible	5.14E-06	5.15E-06	5.16E-06	5.15E-06	2.08E-08	5.75E-06	5.12E-06	9.52E-07	7.63E-07	1.19E-05	5.53E-06	1.46E-08
Other Tissues	1.42E-05	1.42E-05	1.42E-05	1.42E-05	4.29E-08	2.32E-05	1.42E-05	2.62E-06	1.56E-06	3.28E-05	1.55E-05	3.62E-08
Skin	5.79E-06	5.80E-06	5.81E-06	5.81E-06	1.61E-08	6.36E-06	5.76E-06	1.07E-06	5.82E-07	1.29E-05	6.21E-06	1.47E-08
Spinal Col.	9.70E-04	1.46E-03	3.01E-03	5.28E-04	2.53E-03	1.45E-02	7.26E-03	1.66E-04	1.17E-04	3.86E-03	8.05E-03	2.95E-04
Spinal Skel.	1.54E-04	1.92E-04	3.18E-04	1.19E-04	2.02E-04	3.59E-03	7.60E-04	2.71E-05	2.03E-05	5.60E-04	8.97E-04	2.29E-05
Thalami	7.56E-06	7.57E-06	7.59E-06	7.57E-06	2.92E-08	8.42E-06	7.53E-06	1.40E-06	8.80E-07	1.71E-05	8.12E-06	1.94E-08
Thyroid	2.00E-05	2.00E-05	2.00E-05	2.00E-05	4.82E-08	2.19E-05	1.98E-05	3.69E-06	2.31E-06	4.61E-05	2.14E-05	5.04E-08
Trunk	1.22E-06	1.24E-06	1.30E-06	1.21E-06	9.46E-08	3.82E-06	1.53E-06	2.26E-07	1.26E-07	3.12E-06	1.72E-06	1.32E-08
White Matter	4.33E-06	4.33E-06	4.34E-06	4.33E-06	1.21E-08	5.33E-06	4.31E-06	8.01E-07	4.81E-07	1.01E-05	4.67E-06	1.09E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.88E-07	4.97E-06	7.95E-07	4.82E-06	1.77E-07	9.99E-06	1.81E-06	1.03E-05	2.28E-07	3.41E-07	4.53E-07	1.13E-06
Caud. Nucl.	5.24E-07	3.76E-06	6.65E-07	4.01E-06	8.92E-08	8.47E-06	1.54E-06	8.80E-06	1.82E-07	3.08E-07	4.08E-07	9.80E-07
Cerebellum	1.02E-06	8.82E-06	1.42E-06	8.44E-06	3.79E-07	1.75E-05	3.16E-06	1.82E-05	4.25E-07	6.00E-07	7.95E-07	1.96E-06
Cereb. Cort.	5.43E-07	5.09E-06	7.47E-07	4.57E-06	1.80E-07	9.42E-06	1.70E-06	9.78E-06	2.14E-07	3.12E-07	4.15E-07	1.05E-06
Cranium	9.74E-07	1.59E-05	1.56E-06	7.00E-06	9.31E-07	1.20E-05	2.45E-06	1.40E-05	8.03E-07	9.98E-07	1.18E-06	1.50E-06
Eyes	2.04E-07	1.81E-06	2.54E-07	2.03E-06	2.04E-09	4.15E-06	7.17E-07	4.39E-06	4.21E-08	8.05E-08	1.19E-07	4.32E-07
Lent. Nucl.	6.78E-07	4.92E-06	8.76E-07	5.25E-06	1.45E-07	1.10E-05	2.00E-06	1.14E-05	2.45E-07	3.93E-07	5.23E-07	1.26E-06
Mandible	9.04E-07	4.73E-06	1.08E-06	5.03E-06	2.11E-07	1.05E-05	2.00E-06	1.08E-05	4.30E-07	7.61E-07	9.36E-07	1.35E-06
Other Tissues	1.68E-06	1.32E-05	2.31E-06	1.38E-05	5.51E-07	2.88E-05	5.23E-06	2.97E-05	6.94E-07	1.01E-06	1.34E-06	3.25E-06
Skin	6.17E-07	5.30E-06	8.35E-07	5.51E-06	1.48E-07	1.17E-05	2.09E-06	1.19E-05	2.16E-07	3.30E-07	4.48E-07	1.27E-06
Spinal Col.	3.73E-05	6.01E-03	7.73E-05	1.06E-03	6.05E-05	1.04E-03	2.62E-04	2.06E-03	6.13E-05	4.36E-05	4.68E-05	9.11E-05
Spinal Skel.	1.67E-05	6.54E-04	4.06E-05	1.74E-04	3.99E-05	2.39E-04	5.13E-05	3.27E-04	2.38E-05	2.09E-05	2.39E-05	2.77E-05
Thalami	9.62E-07	6.94E-06	1.26E-06	7.28E-06	2.43E-07	1.53E-05	2.83E-06	1.57E-05	3.69E-07	5.82E-07	7.67E-07	1.79E-06
Thyroid	2.53E-06	1.83E-05	3.45E-06	1.94E-05	8.78E-07	4.05E-05	7.45E-06	4.17E-05	1.09E-06	1.59E-06	2.07E-06	4.70E-06
Trunk	1.33E-07	1.40E-06	1.84E-07	1.25E-06	4.37E-08	2.50E-06	4.40E-07	2.66E-06	5.32E-08	7.69E-08	1.02E-07	2.65E-07
White Matter	5.26E-07	3.98E-06	6.93E-07	4.22E-06	1.31E-07	8.76E-06	1.60E-06	9.03E-06	1.96E-07	3.04E-07	4.04E-07	9.96E-07

Table B.24: S values for the 1-year-old Phantom for Sources Located in the Spinal Skeleton.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	3.42E-08	1.10E-10	2.09E-08	1.27E-09	1.51E-07	5.74E-07	8.62E-08	1.77E-06	2.95E-07	1.01E-07	3.32E-07	3.05E-08
Caud. Nucl.	1.19E-08	9.93E-11	9.80E-09	1.22E-09	2.41E-08	5.05E-07	5.48E-08	1.53E-06	2.44E-07	8.70E-08	2.43E-07	2.71E-08
Cerebellum	9.88E-08	1.61E-10	5.56E-08	2.05E-09	4.93E-07	1.01E-06	1.86E-07	3.13E-06	5.34E-07	1.78E-07	6.85E-07	5.43E-08
Cereb. Cort.	4.09E-08	1.11E-10	2.37E-08	1.23E-09	2.09E-07	5.26E-07	8.34E-08	1.65E-06	2.70E-07	9.19E-08	3.36E-07	2.81E-08
Cranium	3.52E-06	2.17E-08	2.61E-06	2.32E-07	6.40E-06	9.42E-07	4.46E-07	2.35E-06	1.20E-06	1.07E-06	4.87E-06	4.52E-08
Eyes	7.46E-09	1.25E-10	5.48E-09	7.36E-10	1.57E-08	2.21E-07	3.84E-09	6.98E-07	7.00E-08	3.29E-08	1.12E-07	1.27E-08
Lent. Nucl.	1.97E-08	1.06E-10	1.48E-08	1.27E-09	3.70E-08	6.94E-07	8.70E-08	2.01E-06	3.57E-07	1.22E-07	3.30E-07	3.63E-08
Mandible	2.53E-08	2.16E-10	1.94E-08	2.38E-09	4.56E-08	9.06E-07	1.66E-07	2.02E-06	6.49E-07	1.89E-07	3.79E-07	4.21E-08
Other Tissues	5.00E-06	2.93E-08	3.64E-06	3.07E-07	1.02E-05	1.84E-06	5.21E-07	6.03E-06	1.53E-06	1.47E-06	7.58E-06	1.00E-07
Skin	1.97E-08	1.76E-10	1.52E-08	1.59E-09	4.78E-08	6.34E-07	1.26E-07	2.14E-06	3.28E-07	1.10E-07	3.30E-07	3.44E-08
Spinal Col.	1.07E-05	3.60E-09	5.11E-06	3.20E-08	6.85E-05	1.10E-05	5.18E-06	3.46E-05	7.29E-06	2.06E-06	3.42E-05	5.94E-07
Spinal Skel.	1.09E-03	1.29E-04	9.25E-04	3.25E-04	1.42E-03	4.39E-05	3.32E-05	3.62E-04	4.71E-04	5.70E-04	1.22E-03	7.75E-03
Thalami	2.66E-08	4.05E-11	2.03E-08	1.68E-09	5.35E-08	9.26E-07	1.38E-07	2.82E-06	4.82E-07	1.63E-07	4.52E-07	4.97E-08
Thyroid	5.67E-08	5.71E-10	4.45E-08	4.05E-09	1.15E-07	2.61E-06	6.28E-07	7.77E-06	1.44E-06	4.54E-07	1.22E-06	1.43E-07
Trunk	7.41E-08	4.16E-10	5.40E-08	4.53E-09	1.53E-07	1.24E-07	2.01E-08	4.15E-07	6.93E-08	3.77E-08	1.61E-07	6.71E-09
White Matter	1.43E-08	9.99E-11	1.09E-08	1.11E-09	2.80E-08	5.12E-07	6.64E-08	1.55E-06	2.60E-07	8.96E-08	2.50E-07	2.70E-08

Table B.25: S values for the 1-year-old Phantom for Sources Located in the Thalami.

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	1.06E-04	1.26E-04	1.72E-04	8.05E-05	1.32E-04	7.20E-04	2.77E-04	2.95E-05	3.36E-05	1.95E-04	3.02E-04	4.82E-05
Caud. Nucl.	8.37E-05	9.17E-05	1.29E-04	7.83E-05	4.70E-05	2.41E-03	3.40E-04	1.49E-05	8.78E-06	3.19E-04	4.28E-04	2.11E-06
Cerebellum	1.31E-05	1.31E-05	1.31E-05	1.31E-05	4.40E-08	1.45E-05	1.30E-05	2.42E-06	1.57E-06	2.99E-05	1.40E-05	3.51E-08
Cereb. Cort.	1.62E-05	1.62E-05	1.63E-05	1.62E-05	5.58E-08	3.79E-05	1.65E-05	3.00E-06	1.89E-06	3.74E-05	1.83E-05	4.36E-08
Cranium	1.16E-05	1.16E-05	1.16E-05	1.16E-05	7.17E-08	1.39E-05	1.16E-05	2.14E-06	1.83E-06	2.64E-05	1.25E-05	3.73E-08
Eyes	8.09E-06	8.10E-06	8.12E-06	8.11E-06	2.47E-08	8.88E-06	8.05E-06	1.50E-06	8.85E-07	1.86E-05	8.67E-06	1.98E-08
Lent. Nucl.	2.22E-04	2.86E-04	4.94E-04	1.65E-04	3.36E-04	5.68E-03	1.24E-03	3.94E-05	2.61E-05	8.53E-04	1.46E-03	4.03E-05
Mandible	6.19E-06	6.20E-06	6.21E-06	6.20E-06	2.78E-08	6.94E-06	6.17E-06	1.15E-06	9.68E-07	1.42E-05	6.66E-06	1.80E-08
Other Tissues	7.01E-06	7.02E-06	7.04E-06	7.02E-06	2.22E-08	7.75E-06	6.97E-06	1.30E-06	8.07E-07	1.60E-05	7.52E-06	1.84E-08
Skin	5.53E-06	5.54E-06	5.55E-06	5.54E-06	1.51E-08	6.08E-06	5.50E-06	1.02E-06	5.67E-07	1.24E-05	5.92E-06	1.44E-08
Spinal Col.	5.35E-06	5.36E-06	5.37E-06	5.36E-06	1.99E-08	5.90E-06	5.33E-06	9.90E-07	6.26E-07	1.18E-05	5.76E-06	1.30E-08
Spinal Skel.	5.23E-06	5.24E-06	5.26E-06	5.24E-06	2.65E-08	5.85E-06	5.22E-06	9.66E-07	9.02E-07	1.16E-05	5.62E-06	1.53E-08
Thalami	6.66E-03	8.17E-03	1.14E-02	4.62E-03	1.04E-02	2.53E-02	1.70E-02	2.13E-03	2.68E-03	9.06E-03	1.78E-02	4.15E-03
Thyroid	2.63E-06	2.63E-06	2.64E-06	2.63E-06	4.26E-09	3.04E-06	2.61E-06	4.88E-07	3.08E-07	6.20E-06	2.85E-06	6.46E-09
Trunk	1.19E-07	1.19E-07	1.20E-07	1.19E-07	2.93E-10	1.34E-07	1.19E-07	2.23E-08	9.48E-09	3.56E-07	1.30E-07	3.01E-10
White Matter	4.32E-05	4.80E-05	6.44E-05	3.90E-05	2.57E-05	6.79E-04	1.30E-04	7.81E-06	5.00E-06	1.32E-04	1.55E-04	2.91E-06

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	7.15E-06	2.31E-04	1.30E-05	6.99E-05	8.90E-06	1.22E-04	4.89E-05	1.62E-04	2.86E-05	1.59E-05	1.23E-05	2.64E-05
Caud. Nucl.	9.62E-06	3.02E-04	1.90E-05	9.59E-05	1.40E-05	1.59E-04	2.94E-05	1.85E-04	7.41E-06	7.38E-06	9.13E-06	1.78E-05
Cerebellum	1.73E-06	1.21E-05	2.68E-06	1.30E-05	1.18E-06	2.66E-05	4.95E-06	2.74E-05	1.00E-06	1.22E-06	1.56E-06	3.16E-06
Cereb. Cort.	2.08E-06	1.54E-05	3.41E-06	1.62E-05	1.74E-06	3.28E-05	6.09E-06	3.37E-05	1.29E-06	1.46E-06	1.87E-06	3.84E-06
Cranium	2.17E-06	1.10E-05	4.24E-06	1.24E-05	3.43E-06	2.35E-05	4.64E-06	2.41E-05	2.40E-06	2.64E-06	3.09E-06	3.18E-06
Eyes	9.60E-07	7.41E-06	1.22E-06	7.73E-06	1.38E-07	1.63E-05	2.98E-06	1.67E-05	3.05E-07	5.18E-07	7.01E-07	1.85E-06
Lent. Nucl.	1.69E-05	1.06E-03	3.43E-05	2.40E-04	2.63E-05	3.25E-04	7.02E-05	4.69E-04	1.75E-05	1.45E-05	1.72E-05	3.40E-05
Mandible	1.15E-06	5.74E-06	1.56E-06	6.17E-06	6.06E-07	1.26E-05	2.45E-06	1.29E-05	7.22E-07	1.09E-06	1.31E-06	1.68E-06
Other Tissues	8.83E-07	6.45E-06	1.27E-06	6.86E-06	4.09E-07	1.42E-05	2.62E-06	1.46E-05	4.22E-07	5.72E-07	7.43E-07	1.65E-06
Skin	6.09E-07	5.06E-06	8.35E-07	5.26E-06	1.84E-07	1.10E-05	2.00E-06	1.13E-05	2.42E-07	3.60E-07	4.77E-07	1.22E-06
Spinal Col.	6.95E-07	4.92E-06	9.45E-07	5.14E-06	2.54E-07	1.09E-05	2.00E-06	1.11E-05	3.14E-07	4.64E-07	5.98E-07	1.26E-06
Spinal Skel.	1.09E-06	4.86E-06	1.50E-06	5.13E-06	6.56E-07	1.05E-05	2.12E-06	1.06E-05	7.45E-07	1.10E-06	1.32E-06	1.50E-06
Thalami	3.24E-04	1.38E-02	5.96E-04	3.32E-03	4.39E-04	5.74E-03	3.38E-03	8.52E-03	2.33E-03	1.19E-03	8.10E-04	1.77E-03
Thyroid	3.38E-07	2.42E-06	4.34E-07	2.62E-06	6.57E-08	5.72E-06	9.97E-07	6.04E-06	1.13E-07	1.79E-07	2.42E-07	6.26E-07
Trunk	9.95E-09	1.11E-07	1.29E-08	1.36E-07	5.82E-10	2.64E-07	4.10E-08	2.90E-07	2.44E-09	4.42E-09	6.30E-09	2.27E-08
White Matter	4.72E-06	1.14E-04	8.73E-06	4.52E-05	5.76E-06	7.83E-05	1.52E-05	9.08E-05	3.67E-06	3.58E-06	4.45E-06	8.88E-06

Table B.26: S values for the 1-year-old Phantom for Sources Located in the Third Ventricle.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	1.07E-04	1.27E-04	1.73E-04	8.16E-05	1.32E-04	7.21E-04	2.78E-04	2.97E-05	3.37E-05	1.97E-04	3.04E-04	4.82E-05
Caud. Nucl.	6.10E-05	6.10E-05	6.12E-05	6.11E-05	2.31E-07	2.07E-04	6.34E-05	1.13E-05	6.92E-06	1.41E-04	7.15E-05	1.73E-07
Cerebellum	1.34E-05	1.34E-05	1.35E-05	1.34E-05	4.79E-08	1.49E-05	1.33E-05	2.48E-06	1.60E-06	3.09E-05	1.44E-05	3.60E-08
Cereb. Cort.	1.62E-05	1.62E-05	1.63E-05	1.62E-05	5.65E-08	2.16E-05	1.62E-05	3.00E-06	1.90E-06	3.69E-05	1.76E-05	4.42E-08
Cranium	1.12E-05	1.12E-05	1.13E-05	1.12E-05	6.58E-08	1.27E-05	1.12E-05	2.07E-06	1.79E-06	2.54E-05	1.21E-05	3.62E-08
Eyes	8.29E-06	8.30E-06	8.33E-06	8.31E-06	2.45E-08	9.04E-06	8.23E-06	1.53E-06	8.90E-07	1.88E-05	8.86E-06	2.03E-08
Lent. Nucl.	8.25E-05	8.27E-05	8.29E-05	8.27E-05	3.57E-07	1.07E-03	1.03E-04	1.53E-05	9.30E-06	2.08E-04	1.33E-04	2.37E-07
Mandible	5.65E-06	5.65E-06	5.67E-06	5.66E-06	2.45E-08	6.28E-06	5.63E-06	1.05E-06	8.90E-07	1.30E-05	6.07E-06	1.63E-08
Other Tissues	6.42E-06	6.43E-06	6.45E-06	6.43E-06	2.00E-08	7.10E-06	6.39E-06	1.19E-06	7.42E-07	1.47E-05	6.90E-06	1.68E-08
Skin	5.33E-06	5.33E-06	5.35E-06	5.34E-06	1.53E-08	5.83E-06	5.29E-06	9.86E-07	5.65E-07	1.21E-05	5.71E-06	1.40E-08
Spinal Col.	5.24E-06	5.25E-06	5.26E-06	5.25E-06	2.00E-08	5.79E-06	5.22E-06	9.66E-07	6.04E-07	1.15E-05	5.63E-06	1.31E-08
Spinal Skel.	5.05E-06	5.06E-06	5.08E-06	5.06E-06	2.62E-08	5.63E-06	5.04E-06	9.33E-07	8.68E-07	1.10E-05	5.43E-06	1.51E-08
Thalami	2.61E-04	2.69E-04	3.97E-04	2.58E-04	1.23E-04	1.57E-02	1.83E-03	4.83E-05	2.77E-05	1.50E-03	2.44E-03	1.17E-06
Thyroid	2.68E-06	2.69E-06	2.70E-06	2.69E-06	1.03E-08	3.03E-06	2.69E-06	5.01E-07	2.47E-07	6.47E-06	2.94E-06	6.08E-09
Trunk	1.15E-07	1.15E-07	1.15E-07	1.15E-07	2.16E-10	1.28E-07	1.14E-07	2.15E-08	8.91E-09	3.48E-07	1.25E-07	2.75E-10
White Matter	7.36E-05	9.53E-05	1.60E-04	5.36E-05	1.10E-04	8.84E-04	3.27E-04	1.31E-05	8.85E-06	2.29E-04	3.65E-04	1.40E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	7.28E-06	2.32E-04	1.33E-05	7.09E-05	9.06E-06	1.24E-04	4.93E-05	1.64E-04	2.87E-05	1.60E-05	1.25E-05	2.66E-05
Caud. Nucl.	7.77E-06	5.99E-05	1.46E-05	6.17E-05	9.89E-06	1.23E-04	2.28E-05	1.26E-04	5.79E-06	5.58E-06	7.07E-06	1.42E-05
Cerebellum	1.75E-06	1.24E-05	2.74E-06	1.33E-05	1.22E-06	2.72E-05	5.07E-06	2.81E-05	1.03E-06	1.24E-06	1.58E-06	3.23E-06
Cereb. Cort.	2.09E-06	1.51E-05	3.40E-06	1.61E-05	1.69E-06	3.28E-05	6.11E-06	3.36E-05	1.29E-06	1.47E-06	1.88E-06	3.86E-06
Cranium	2.12E-06	1.06E-05	3.98E-06	1.18E-05	3.09E-06	2.26E-05	4.48E-06	2.31E-05	2.27E-06	2.58E-06	3.02E-06	3.08E-06
Eyes	9.43E-07	7.57E-06	1.23E-06	7.88E-06	1.52E-07	1.67E-05	3.06E-06	1.70E-05	3.02E-07	5.04E-07	6.85E-07	1.90E-06
Lent. Nucl.	1.05E-05	9.94E-05	2.05E-05	8.42E-05	1.47E-05	1.67E-04	3.09E-05	1.71E-04	8.08E-06	7.58E-06	9.56E-06	1.93E-05
Mandible	1.06E-06	5.23E-06	1.40E-06	5.59E-06	4.99E-07	1.14E-05	2.24E-06	1.17E-05	6.38E-07	9.86E-07	1.19E-06	1.54E-06
Other Tissues	8.14E-07	5.91E-06	1.15E-06	6.28E-06	3.50E-07	1.30E-05	2.40E-06	1.34E-05	3.80E-07	5.25E-07	6.83E-07	1.51E-06
Skin	6.08E-07	4.88E-06	8.29E-07	5.13E-06	1.81E-07	1.08E-05	1.95E-06	1.11E-05	2.40E-07	3.55E-07	4.72E-07	1.20E-06
Spinal Col.	6.85E-07	4.82E-06	9.28E-07	4.94E-06	2.60E-07	1.05E-05	1.93E-06	1.07E-05	3.07E-07	4.33E-07	5.63E-07	1.21E-06
Spinal Skel.	1.05E-06	4.69E-06	1.42E-06	4.91E-06	5.96E-07	1.01E-05	2.05E-06	1.02E-05	6.97E-07	1.05E-06	1.25E-06	1.45E-06
Thalami	3.24E-05	1.64E-03	6.85E-05	3.38E-04	5.60E-05	5.25E-04	9.60E-05	6.21E-04	2.55E-05	2.51E-05	3.08E-05	5.93E-05
Thyroid	2.80E-07	2.49E-06	3.51E-07	2.79E-06	4.12E-08	5.93E-06	9.39E-07	6.39E-06	8.97E-08	1.47E-07	1.99E-07	5.35E-07
Trunk	9.34E-09	1.07E-07	1.21E-08	1.32E-07	4.80E-10	2.56E-07	3.93E-08	2.81E-07	2.27E-09	4.18E-09	5.94E-09	2.16E-08
White Matter	5.46E-06	2.75E-04	1.03E-05	7.51E-05	6.93E-06	1.06E-04	2.32E-05	1.51E-04	5.52E-06	4.67E-06	5.55E-06	1.11E-05

Table B.27: S values for the 1-year-old Phantom for Sources Located in the Thyroid.

Targets	S values (mGy $MBq^{-1}s^{-1}$)											
	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{125m}I	^{126}I	^{130}I	^{131}I	^{132}I	^{132m}I	^{133}I
Brain (Total)	1.93E-07	1.65E-06	2.48E-07	1.81E-06	2.54E-08	7.41E-07	1.86E-08	3.73E-06	6.50E-07	3.91E-06	5.49E-07	1.06E-06
Caud. Nucl.	2.35E-07	1.94E-06	3.03E-07	2.10E-06	2.58E-08	8.72E-07	1.92E-08	4.35E-06	7.84E-07	4.52E-06	6.41E-07	1.24E-06
Cerebellum	1.91E-07	1.73E-06	2.40E-07	1.90E-06	1.37E-08	7.69E-07	1.08E-08	3.89E-06	6.71E-07	4.08E-06	5.68E-07	1.11E-06
Cereb. Cort.	1.76E-07	1.55E-06	2.27E-07	1.70E-06	2.40E-08	6.94E-07	1.74E-08	3.50E-06	6.05E-07	3.67E-06	5.14E-07	9.94E-07
Cranium	2.83E-07	1.57E-06	3.57E-07	1.72E-06	9.66E-08	7.25E-07	6.89E-08	3.49E-06	6.51E-07	3.64E-06	5.39E-07	9.95E-07
Eyes	1.70E-07	1.67E-06	2.12E-07	1.79E-06	1.24E-09	7.43E-07	1.98E-09	3.80E-06	6.41E-07	3.97E-06	5.53E-07	1.07E-06
Lent. Nucl.	3.30E-07	2.58E-06	4.15E-07	2.71E-06	4.67E-08	1.16E-06	3.49E-08	5.81E-06	1.03E-06	6.01E-06	8.63E-07	1.65E-06
Mandible	9.16E-07	4.56E-06	1.33E-06	4.90E-06	6.41E-07	2.18E-06	4.32E-07	9.89E-06	1.94E-06	1.01E-05	1.62E-06	2.84E-06
Other Tissues	2.28E-06	1.02E-04	4.21E-06	2.87E-05	2.75E-06	1.14E-05	1.50E-06	4.33E-05	8.90E-06	5.74E-05	8.48E-06	2.25E-05
Skin	5.06E-07	4.45E-06	8.28E-07	4.40E-06	3.94E-07	1.92E-06	2.24E-07	9.06E-06	1.64E-06	9.31E-06	1.41E-06	2.60E-06
Spinal Col.	2.38E-06	1.90E-05	3.38E-06	1.99E-05	9.31E-07	8.52E-06	6.26E-07	4.13E-05	7.59E-06	4.22E-05	6.23E-06	1.19E-05
Spinal Skel.	3.46E-06	1.90E-05	6.17E-06	2.07E-05	4.35E-06	9.36E-06	2.73E-06	4.04E-05	7.84E-06	4.14E-05	6.93E-06	1.16E-05
Thalami	3.35E-07	2.60E-06	4.33E-07	2.77E-06	6.42E-08	1.14E-06	4.58E-08	5.56E-06	1.04E-06	5.67E-06	8.22E-07	1.62E-06
Thyroid	1.61E-03	5.48E-02	2.92E-03	1.43E-02	2.13E-03	1.27E-02	6.03E-03	2.73E-02	1.75E-02	3.91E-02	1.35E-02	3.32E-02
Trunk	3.37E-07	3.53E-06	5.29E-07	2.90E-06	2.33E-07	1.22E-06	1.39E-07	5.78E-06	1.05E-06	6.09E-06	9.05E-07	1.70E-06
White Matter	2.02E-07	1.69E-06	2.59E-07	1.85E-06	2.80E-08	7.59E-07	2.05E-08	3.81E-06	6.66E-07	4.00E-06	5.62E-07	1.08E-06

Table B.28: S values for the 1-year-old Phantom for Sources Located in the White Matter.

Targets	S values (mGy $MBq^{-1}s^{-1}$)											
	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	1.02E-04	1.22E-04	1.68E-04	7.64E-05	1.32E-04	6.98E-04	2.73E-04	2.87E-05	3.30E-05	1.85E-04	2.97E-04	4.82E-05
Caud. Nucl.	4.93E-05	5.66E-05	8.11E-05	4.29E-05	3.87E-05	8.59E-04	1.75E-04	8.89E-06	5.86E-06	1.60E-04	2.08E-04	4.43E-06
Cerebellum	1.15E-05	1.15E-05	1.15E-05	1.15E-05	4.06E-08	3.26E-05	1.18E-05	2.13E-06	1.32E-06	2.68E-05	1.32E-05	3.04E-08
Cereb. Cort.	2.34E-05	2.58E-05	3.41E-05	2.13E-05	1.30E-05	3.27E-04	6.74E-05	4.24E-06	2.64E-06	7.06E-05	8.00E-05	1.46E-06
Cranium	1.29E-05	1.29E-05	1.29E-05	1.29E-05	8.28E-08	8.21E-05	1.43E-05	2.38E-06	1.89E-06	3.10E-05	1.70E-05	4.33E-08
Eyes	1.02E-05	1.02E-05	1.02E-05	1.02E-05	2.55E-08	1.16E-05	1.02E-05	1.89E-06	1.06E-06	2.27E-05	1.10E-05	2.49E-08
Lent. Nucl.	4.29E-05	4.83E-05	6.61E-05	3.82E-05	2.82E-05	6.52E-04	1.35E-04	7.75E-06	4.92E-06	1.33E-04	1.60E-04	3.23E-06
Mandible	4.15E-06	4.16E-06	4.17E-06	4.16E-06	1.73E-08	5.22E-06	4.15E-06	7.70E-07	6.10E-07	9.73E-06	4.49E-06	1.18E-08
Other Tissues	4.47E-06	4.48E-06	4.49E-06	4.48E-06	1.31E-08	6.60E-06	4.48E-06	8.28E-07	4.88E-07	1.03E-05	4.87E-06	1.15E-08
Skin	6.53E-06	6.54E-06	6.56E-06	6.55E-06	1.84E-08	1.81E-05	6.71E-06	1.21E-06	6.81E-07	1.49E-05	7.48E-06	1.72E-08
Spinal Col.	3.33E-06	3.34E-06	3.35E-06	3.34E-06	9.86E-09	4.19E-06	3.32E-06	6.17E-07	3.88E-07	7.38E-06	3.60E-06	8.19E-09
Spinal Skel.	3.28E-06	3.29E-06	3.30E-06	3.29E-06	1.68E-08	4.11E-06	3.28E-06	6.07E-07	5.30E-07	7.43E-06	3.55E-06	9.64E-09
Thalami	4.32E-05	4.80E-05	6.43E-05	3.90E-05	2.55E-05	6.52E-04	1.30E-04	7.80E-06	4.93E-06	1.31E-04	1.55E-04	2.89E-06
Thyroid	1.53E-06	1.53E-06	1.54E-06	1.53E-06	9.03E-09	1.98E-06	1.53E-06	2.84E-07	1.62E-07	4.13E-06	1.69E-06	3.59E-09
Trunk	7.24E-08	7.24E-08	7.26E-08	7.25E-08	1.37E-10	8.11E-08	7.20E-08	1.36E-08	5.51E-09	2.25E-07	7.92E-08	1.80E-10
White Matter	2.07E-04	2.50E-04	3.47E-04	1.50E-04	2.92E-04	1.22E-03	5.49E-04	6.13E-05	7.35E-05	3.41E-04	5.91E-04	1.11E-04

Targets	S values (mGy $MBq^{-1}s^{-1}$)											
	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	6.56E-06	2.27E-04	1.20E-05	6.58E-05	8.28E-06	1.14E-04	4.73E-05	1.53E-04	2.82E-05	1.54E-05	1.18E-05	2.53E-05
Caud. Nucl.	5.21E-06	1.52E-04	9.79E-06	5.26E-05	6.66E-06	8.71E-05	1.72E-05	1.06E-04	4.25E-06	3.98E-06	4.91E-06	9.81E-06
Cerebellum	1.44E-06	1.11E-05	2.35E-06	1.15E-05	1.16E-06	2.32E-05	4.31E-06	2.39E-05	8.70E-07	9.99E-07	1.28E-06	2.71E-06
Cereb. Cort.	2.49E-06	5.92E-05	4.47E-06	2.45E-05	2.76E-06	4.30E-05	8.23E-06	4.96E-05	1.83E-06	1.83E-06	2.29E-06	4.78E-06
Cranium	2.25E-06	1.39E-05	5.01E-06	1.41E-05	4.60E-06	2.61E-05	5.10E-06	2.69E-05	2.77E-06	2.71E-06	3.17E-06	3.40E-06
Eyes	1.12E-06	9.36E-06	1.53E-06	9.69E-06	3.02E-07	2.06E-05	3.73E-06	2.10E-05	4.10E-07	6.15E-07	8.30E-07	2.29E-06
Lent. Nucl.	4.53E-06	1.18E-04	8.38E-06	4.51E-05	5.53E-06	7.66E-05	1.50E-05	9.02E-05	3.58E-06	3.48E-06	4.31E-06	8.59E-06
Mandible	7.21E-07	3.86E-06	9.57E-07	4.15E-06	3.33E-07	8.43E-06	1.61E-06	8.68E-06	4.18E-07	6.43E-07	7.83E-07	1.09E-06
Other Tissues	5.31E-07	4.15E-06	7.52E-07	4.38E-06	2.19E-07	9.09E-06	1.65E-06	9.37E-06	2.37E-07	3.28E-07	4.30E-07	1.02E-06
Skin	7.28E-07	6.24E-06	1.10E-06	6.32E-06	3.97E-07	1.32E-05	2.39E-06	1.35E-05	3.51E-07	4.41E-07	5.82E-07	1.46E-06
Spinal Col.	4.32E-07	3.07E-06	5.73E-07	3.21E-06	1.31E-07	6.81E-06	1.24E-06	7.01E-06	1.72E-07	2.55E-07	3.36E-07	7.82E-07
Spinal Skel.	6.29E-07	3.05E-06	8.45E-07	3.23E-06	3.23E-07	6.62E-06	1.31E-06	6.76E-06	3.92E-07	5.99E-07	7.23E-07	9.13E-07
Thalami	4.68E-06	1.14E-04	8.58E-06	4.48E-05	5.62E-06	7.80E-05	1.51E-05	9.03E-05	3.61E-06	3.54E-06	4.39E-06	8.76E-06
Thyroid	1.69E-07	1.43E-06	2.20E-07	1.62E-06	2.35E-08	3.49E-06	5.71E-07	3.78E-06	5.44E-08	9.68E-08	1.30E-07	3.48E-07
Trunk	5.74E-09	6.73E-08	7.49E-09	8.47E-08	2.29E-10	1.63E-07	2.48E-08	1.81E-07	1.30E-09	2.38E-09	3.46E-09	1.35E-08
White Matter	1.20E-05	4.53E-04	2.20E-05	1.21E-04	1.57E-05	2.09E-04	9.95E-05	2.92E-04	6.33E-05	3.36E-05	2.44E-05	5.27E-05

S Values in a Mathematical Model of the Head and Brain of a Five Year-Old

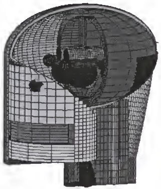


Table B.29: S values for the 5-year-old Phantom for Sources Located in the Brain (total).

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.15E-05	8.51E-05	1.16E-04	5.39E-05	9.10E-05	4.50E-04	1.85E-04	2.02E-05	2.32E-05	1.28E-04	2.01E-04	3.37E-05
Caud. Nucl.	7.66E-05	9.06E-05	1.23E-04	5.86E-05	9.33E-05	5.11E-04	1.97E-04	2.11E-05	2.40E-05	1.42E-04	2.15E-04	3.40E-05
Cerebellum	7.00E-05	8.35E-05	1.14E-04	5.24E-05	9.07E-05	4.33E-04	1.82E-04	1.99E-05	2.31E-05	1.23E-04	1.97E-04	3.37E-05
Cereb. Cort.	6.84E-05	8.16E-05	1.12E-04	5.12E-05	8.89E-05	3.97E-04	1.75E-04	1.96E-05	2.28E-05	1.18E-04	1.89E-04	3.34E-05
Cranium	1.17E-05	1.26E-05	1.62E-05	1.11E-05	4.75E-06	1.45E-04	3.26E-05	2.09E-06	1.65E-06	3.66E-05	3.86E-05	1.97E-07
Eyes	7.30E-06	7.31E-06	7.33E-06	7.31E-06	2.37E-08	1.87E-05	7.52E-06	1.35E-06	7.79E-07	1.71E-05	8.36E-06	1.83E-08
Lent. Nucl.	7.65E-05	9.06E-05	1.23E-04	5.85E-05	9.36E-05	5.08E-04	1.98E-04	2.11E-05	2.38E-05	1.42E-04	2.16E-04	3.39E-05
Mandible	3.22E-06	3.23E-06	3.24E-06	3.23E-06	1.32E-08	5.07E-06	3.26E-06	5.97E-07	4.70E-07	7.58E-06	3.55E-06	8.96E-09
Other Tissues	3.56E-06	3.56E-06	3.57E-06	3.56E-06	1.15E-08	8.98E-06	3.69E-06	6.59E-07	3.92E-07	8.46E-06	4.11E-06	9.23E-09
Skin	5.36E-06	5.36E-06	5.39E-06	5.37E-06	2.48E-08	3.34E-05	6.47E-06	9.91E-07	5.59E-07	1.30E-05	7.69E-06	1.39E-08
Spinal Col.	2.86E-06	2.86E-06	2.87E-06	2.86E-06	8.04E-09	6.62E-06	2.93E-06	5.30E-07	3.29E-07	6.90E-06	3.25E-06	7.20E-09
Spinal Skel.	2.85E-06	2.86E-06	2.87E-06	2.86E-06	1.25E-08	6.16E-06	2.92E-06	5.28E-07	4.53E-07	6.68E-06	3.22E-06	7.65E-09
Thalami	7.74E-05	9.14E-05	1.24E-04	5.95E-05	9.29E-05	5.08E-04	1.97E-04	2.13E-05	2.40E-05	1.43E-04	2.15E-04	3.39E-05
Thyroid	1.35E-06	1.35E-06	1.35E-06	1.36E-06	7.55E-10	1.55E-06	1.34E-06	2.52E-07	1.06E-07	3.45E-06	1.45E-06	3.05E-09
Trunk	3.93E-08	3.93E-08	3.94E-08	3.94E-08	7.37E-11	4.42E-08	3.91E-08	7.39E-09	2.88E-09	1.26E-07	4.30E-08	9.22E-11
White Matter	7.43E-05	8.82E-05	1.21E-04	5.64E-05	9.31E-05	4.99E-04	1.95E-04	2.07E-05	2.36E-05	1.36E-04	2.12E-04	3.40E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.67E-06	1.54E-04	8.40E-06	4.60E-05	5.65E-06	8.06E-05	3.33E-05	1.07E-04	1.98E-05	1.09E-05	8.30E-06	1.79E-05
Caud. Nucl.	5.38E-06	1.64E-04	9.69E-06	5.15E-05	6.44E-06	9.08E-05	3.53E-05	1.19E-04	2.03E-05	1.14E-05	8.95E-06	1.91E-05
Cerebellum	4.46E-06	1.51E-04	8.05E-06	4.43E-05	5.43E-06	7.75E-05	3.28E-05	1.04E-04	1.97E-05	1.07E-05	8.11E-06	1.75E-05
Cereb. Cort.	4.33E-06	1.45E-04	7.76E-06	4.28E-05	5.21E-06	7.52E-05	3.22E-05	1.01E-04	1.94E-05	1.06E-05	7.96E-06	1.72E-05
Cranium	1.95E-06	2.90E-05	4.25E-06	1.38E-05	3.85E-06	2.29E-05	4.43E-06	2.58E-05	2.29E-06	2.32E-06	2.71E-06	2.92E-06
Eyes	8.37E-07	6.98E-06	1.16E-06	7.15E-06	2.81E-07	1.48E-05	2.68E-06	1.53E-05	3.38E-07	4.90E-07	6.51E-07	1.65E-06
Lent. Nucl.	5.28E-06	1.65E-04	9.51E-06	5.12E-05	6.37E-06	9.00E-05	3.51E-05	1.18E-04	2.02E-05	1.13E-05	8.89E-06	1.90E-05
Mandible	5.58E-07	3.02E-06	7.01E-07	3.18E-06	1.87E-07	6.54E-06	1.25E-06	6.73E-06	2.84E-07	4.61E-07	5.68E-07	8.38E-07
Other Tissues	4.27E-07	3.43E-06	5.88E-07	3.52E-06	1.48E-07	7.29E-06	1.32E-06	7.55E-06	1.77E-07	2.55E-07	3.37E-07	8.16E-07
Skin	5.95E-07	6.03E-06	8.80E-07	5.22E-06	2.82E-07	1.09E-05	1.96E-06	1.12E-05	2.66E-07	3.45E-07	4.59E-07	1.20E-06
Spinal Col.	3.44E-07	2.72E-06	4.78E-07	2.87E-06	1.04E-07	5.91E-06	1.09E-06	6.16E-06	1.29E-07	1.87E-07	2.54E-07	6.92E-07
Spinal Skel.	5.44E-07	2.72E-06	7.10E-07	2.84E-06	2.46E-07	5.81E-06	1.13E-06	5.97E-06	3.16E-07	4.87E-07	5.93E-07	7.80E-07
Thalami	5.42E-06	1.64E-04	9.74E-06	5.19E-05	6.52E-06	9.17E-05	3.55E-05	1.19E-04	2.04E-05	1.15E-05	9.06E-06	1.93E-05
Thyroid	1.13E-07	1.24E-06	1.52E-07	1.41E-06	2.01E-08	2.80E-06	4.57E-07	2.96E-06	3.98E-08	6.82E-08	8.99E-08	2.54E-07
Trunk	3.00E-09	3.66E-08	3.92E-09	4.70E-08	8.22E-11	8.88E-08	1.33E-08	9.91E-08	6.38E-10	1.17E-09	1.73E-09	7.15E-09
White Matter	4.96E-06	1.62E-04	8.96E-06	4.88E-05	6.03E-06	8.54E-05	3.43E-05	1.13E-04	2.01E-05	1.11E-05	8.60E-06	1.85E-05

Table B.30: S values for the 5-year-old Phantom for Sources Located in the Caudate Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.71E-05	9.10E-05	1.23E-04	5.92E-05	9.28E-05	5.09E-04	1.97E-04	2.12E-05	2.39E-05	1.43E-04	2.15E-04	3.39E-05
Caud. Nucl.	6.85E-03	8.37E-03	1.15E-02	4.76E-03	1.06E-02	2.06E-02	1.65E-02	2.22E-03	2.82E-03	8.67E-03	1.71E-02	4.36E-03
Cerebellum	6.60E-06	6.61E-06	6.63E-06	6.62E-06	2.16E-08	7.30E-06	6.57E-06	1.22E-06	7.94E-07	1.52E-05	7.09E-06	1.70E-08
Cereb. Cort.	1.24E-05	1.24E-05	1.25E-05	1.24E-05	4.25E-08	1.49E-05	1.24E-05	2.30E-06	1.46E-06	2.82E-05	1.34E-05	3.35E-08
Cranium	8.47E-06	8.48E-06	8.51E-06	8.48E-06	4.65E-08	9.51E-06	8.46E-06	1.57E-06	1.38E-06	1.94E-05	9.13E-06	2.63E-08
Eyes	1.05E-05	1.06E-05	1.06E-05	1.06E-05	3.25E-08	1.15E-05	1.05E-05	1.95E-06	1.16E-06	2.39E-05	1.13E-05	2.89E-08
Lent. Nucl.	1.56E-04	1.98E-04	3.39E-04	1.17E-04	2.25E-04	3.93E-03	8.53E-04	2.76E-05	1.82E-05	5.98E-04	1.01E-03	2.67E-05
Mandible	4.19E-06	4.19E-06	4.21E-06	4.20E-06	1.62E-08	4.64E-06	4.18E-06	7.76E-07	6.45E-07	9.79E-06	4.50E-06	1.17E-08
Other Tissues	3.69E-06	3.69E-06	3.70E-06	3.69E-06	1.01E-08	4.06E-06	3.66E-06	6.83E-07	4.16E-07	8.54E-06	3.96E-06	9.36E-09
Skin	4.36E-06	4.36E-06	4.37E-06	4.37E-06	1.10E-08	4.79E-06	4.33E-06	8.07E-07	4.64E-07	1.00E-05	4.68E-06	1.09E-08
Spinal Col.	1.81E-06	1.82E-06	1.82E-06	1.82E-06	4.30E-09	2.07E-06	1.80E-06	3.35E-07	2.34E-07	4.16E-06	1.95E-06	4.37E-09
Spinal Skel.	2.00E-06	2.00E-06	2.01E-06	2.00E-06	8.78E-09	2.23E-06	2.00E-06	3.70E-07	3.46E-07	4.43E-06	2.15E-06	5.66E-09
Thalami	6.23E-05	6.64E-05	8.56E-05	5.97E-05	2.41E-05	1.49E-03	2.03E-04	1.12E-05	6.87E-06	2.14E-04	2.56E-04	1.05E-06
Thyroid	1.65E-06	1.66E-06	1.66E-06	1.66E-06	5.05E-09	1.90E-06	1.64E-06	3.06E-07	1.37E-07	3.83E-06	1.77E-06	4.47E-09
Trunk	4.05E-08	4.05E-08	4.06E-08	4.06E-08	7.45E-11	4.55E-08	4.03E-08	7.60E-09	2.98E-09	1.26E-07	4.42E-08	9.68E-11
White Matter	3.83E-05	4.30E-05	5.89E-05	3.42E-05	2.50E-05	5.75E-04	1.20E-04	6.92E-06	4.46E-06	1.18E-04	1.42E-04	2.86E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.38E-06	1.65E-04	9.67E-06	5.17E-05	6.47E-06	9.12E-05	3.54E-05	1.19E-04	2.03E-05	1.14E-05	8.98E-06	1.91E-05
Caud. Nucl.	3.29E-04	1.34E-02	6.02E-04	3.27E-03	4.40E-04	5.79E-03	3.52E-03	8.56E-03	2.45E-03	1.25E-03	8.44E-04	1.85E-03
Cerebellum	8.75E-07	6.09E-06	1.24E-06	6.51E-06	4.06E-07	1.34E-05	2.49E-06	1.38E-05	4.31E-07	5.90E-07	7.60E-07	1.59E-06
Cereb. Cort.	1.61E-06	1.15E-05	2.52E-06	1.23E-05	1.15E-06	2.50E-05	4.67E-06	2.57E-05	9.36E-07	1.12E-06	1.43E-06	2.96E-06
Cranium	1.64E-06	8.00E-06	2.83E-06	8.85E-06	1.95E-06	1.71E-05	3.41E-06	1.75E-05	1.55E-06	1.87E-06	2.21E-06	2.36E-06
Eyes	1.25E-06	9.67E-06	1.73E-06	1.02E-05	4.23E-07	2.14E-05	3.91E-06	2.20E-05	5.14E-07	7.33E-07	9.74E-07	2.43E-06
Lent. Nucl.	1.22E-05	7.30E-04	2.47E-05	1.70E-04	1.87E-05	2.34E-04	4.96E-05	3.32E-04	1.23E-05	1.05E-05	1.25E-05	2.44E-05
Mandible	7.70E-07	3.86E-06	9.52E-07	4.14E-06	2.44E-07	8.46E-06	1.65E-06	8.69E-06	3.89E-07	6.39E-07	7.87E-07	1.13E-06
Other Tissues	4.54E-07	3.38E-06	6.00E-07	3.60E-06	1.19E-07	7.49E-06	1.37E-06	7.73E-06	1.75E-07	2.71E-07	3.57E-07	8.56E-07
Skin	4.97E-07	4.00E-06	6.78E-07	4.23E-06	1.43E-07	8.87E-06	1.60E-06	9.15E-06	1.90E-07	2.80E-07	3.76E-07	9.87E-07
Spinal Col.	2.61E-07	1.66E-06	3.20E-07	1.74E-06	4.02E-08	3.70E-06	6.97E-07	3.81E-06	9.05E-08	1.55E-07	2.05E-07	4.55E-07
Spinal Skel.	4.20E-07	1.84E-06	4.93E-07	1.91E-06	1.04E-07	3.98E-06	8.12E-07	4.04E-06	2.03E-07	3.52E-07	4.33E-07	5.76E-07
Thalami	7.61E-06	1.82E-04	1.45E-05	6.88E-05	1.02E-05	1.21E-04	2.25E-05	1.35E-04	5.65E-06	5.73E-06	7.15E-06	1.39E-05
Thyroid	1.48E-07	1.51E-06	1.91E-07	1.59E-06	1.64E-08	3.35E-06	5.64E-07	3.46E-06	4.34E-08	7.47E-08	1.03E-07	3.18E-07
Trunk	3.13E-09	3.77E-08	4.05E-09	4.74E-08	8.42E-11	9.08E-08	1.37E-08	1.01E-07	6.83E-10	1.26E-09	1.85E-09	7.35E-09
White Matter	4.13E-06	1.05E-04	7.57E-06	4.02E-05	4.93E-06	6.87E-05	1.34E-05	8.07E-05	3.22E-06	3.15E-06	3.90E-06	7.76E-06

Table B.31: S values for the 5-year-old Phantom for Sources Located in the Cerebellum.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.97E-05	8.32E-05	1.14E-04	5.22E-05	9.04E-05	4.34E-04	1.82E-04	1.98E-05	2.30E-05	1.23E-04	1.97E-04	3.36E-05
Caud. Nucl.	6.84E-06	6.85E-06	6.87E-06	6.85E-06	2.31E-08	7.48E-06	6.80E-06	1.26E-06	7.99E-07	1.52E-05	7.31E-06	1.81E-08
Cerebellum	5.80E-04	7.08E-04	9.94E-04	4.13E-04	8.60E-04	3.49E-03	1.59E-03	1.75E-04	2.13E-04	9.37E-04	1.71E-03	3.26E-04
Cereb. Cort.	1.45E-05	1.56E-05	1.97E-05	1.34E-05	6.34E-06	1.68E-04	3.59E-05	2.63E-06	1.64E-06	4.15E-05	4.24E-05	7.38E-07
Cranium	1.28E-05	1.39E-05	1.86E-05	1.21E-05	6.08E-06	1.86E-04	4.00E-05	2.27E-06	1.76E-06	4.20E-05	4.77E-05	2.41E-07
Eyes	1.69E-06	1.69E-06	1.69E-06	1.69E-06	1.61E-09	1.89E-06	1.68E-06	3.15E-07	1.65E-07	4.33E-06	1.83E-06	3.83E-09
Lent. Nucl.	7.04E-06	7.05E-06	7.07E-06	7.05E-06	2.78E-08	7.71E-06	7.01E-06	1.30E-06	8.84E-07	1.61E-05	7.57E-06	2.01E-08
Mandible	2.02E-06	2.02E-06	2.03E-06	2.02E-06	6.85E-09	2.26E-06	2.01E-06	3.75E-07	2.89E-07	4.86E-06	2.18E-06	5.61E-09
Other Tissues	4.55E-06	4.55E-06	4.56E-06	4.55E-06	1.39E-08	1.62E-05	4.84E-06	8.42E-07	4.91E-07	1.09E-05	5.49E-06	1.17E-08
Skin	5.28E-06	5.29E-06	5.31E-06	5.29E-06	1.98E-08	2.77E-05	6.00E-06	9.77E-07	5.47E-07	1.24E-05	7.01E-06	1.37E-08
Spinal Col.	6.67E-06	6.67E-06	6.69E-06	6.68E-06	1.63E-08	1.58E-05	6.84E-06	1.24E-06	6.84E-07	1.54E-05	7.62E-06	1.65E-08
Spinal Skel.	6.26E-06	6.27E-06	6.28E-06	6.27E-06	2.61E-08	1.73E-05	6.52E-06	1.16E-06	9.15E-07	1.47E-05	7.28E-06	1.79E-08
Thalami	1.07E-05	1.07E-05	1.08E-05	1.07E-05	3.50E-08	1.17E-05	1.07E-05	1.98E-06	1.33E-06	2.48E-05	1.15E-05	2.80E-08
Thyroid	1.84E-06	1.84E-06	1.84E-06	1.84E-06	2.56E-09	2.01E-06	1.82E-06	3.40E-07	1.47E-07	4.27E-06	1.96E-06	4.12E-09
Trunk	5.45E-08	5.46E-08	5.47E-08	5.46E-08	9.53E-11	6.16E-08	5.42E-08	1.03E-08	3.85E-09	1.77E-07	5.98E-08	1.31E-10
White Matter	9.22E-06	9.23E-06	9.25E-06	9.24E-06	3.08E-08	2.03E-05	9.37E-06	1.71E-06	1.08E-06	2.14E-05	1.03E-05	2.46E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.45E-06	1.51E-04	8.03E-06	4.41E-05	5.43E-06	7.72E-05	3.27E-05	1.04E-04	1.96E-05	1.07E-05	8.10E-06	1.75E-05
Caud. Nucl.	8.85E-07	6.28E-06	1.26E-06	6.50E-06	4.10E-07	1.36E-05	2.55E-06	1.38E-05	4.36E-07	5.94E-07	7.65E-07	1.61E-06
Cerebellum	3.15E-05	1.31E-03	5.87E-05	3.29E-04	4.29E-05	5.58E-04	2.82E-04	8.01E-04	1.84E-04	9.63E-05	6.85E-05	1.48E-04
Cereb. Cort.	1.60E-06	3.17E-05	2.77E-06	1.49E-05	1.59E-06	2.71E-05	5.16E-06	3.05E-05	1.10E-06	1.15E-06	1.45E-06	3.05E-06
Cranium	2.09E-06	3.55E-05	4.72E-06	1.53E-05	4.43E-06	2.48E-05	4.79E-06	2.83E-05	2.53E-06	2.48E-06	2.90E-06	3.14E-06
Eyes	1.78E-07	1.56E-06	2.21E-07	1.77E-06	8.70E-09	3.63E-06	6.09E-07	3.87E-06	4.49E-08	8.30E-08	1.16E-07	3.62E-07
Lent. Nucl.	9.70E-07	6.49E-06	1.37E-06	6.92E-06	4.29E-07	1.44E-05	2.70E-06	1.49E-05	4.67E-07	6.50E-07	8.38E-07	1.75E-06
Mandible	3.40E-07	1.86E-06	3.95E-07	2.01E-06	5.28E-08	4.17E-06	7.81E-07	4.33E-06	1.42E-07	2.61E-07	3.26E-07	5.21E-07
Other Tissues	5.31E-07	4.51E-06	7.53E-07	4.49E-06	2.15E-07	9.28E-06	1.67E-06	9.60E-06	2.32E-07	3.22E-07	4.24E-07	1.03E-06
Skin	5.83E-07	5.60E-06	8.73E-07	5.11E-06	2.95E-07	1.07E-05	1.93E-06	1.09E-05	2.69E-07	3.42E-07	4.55E-07	1.18E-06
Spinal Col.	7.41E-07	6.36E-06	1.04E-06	6.56E-06	2.64E-07	1.40E-05	2.42E-06	1.46E-05	3.11E-07	4.49E-07	5.92E-07	1.46E-06
Spinal Skel.	1.08E-06	6.09E-06	1.51E-06	6.28E-06	6.28E-07	1.28E-05	2.43E-06	1.32E-05	6.96E-07	1.02E-06	1.23E-06	1.63E-06
Thalami	1.46E-06	9.88E-06	2.18E-06	1.06E-05	8.55E-07	2.14E-05	4.09E-06	2.19E-05	7.99E-07	1.04E-06	1.32E-06	2.65E-06
Thyroid	1.58E-07	1.67E-06	2.03E-07	1.78E-06	1.33E-08	3.61E-06	6.22E-07	3.70E-06	4.15E-08	7.21E-08	1.02E-07	3.50E-07
Trunk	3.98E-09	5.09E-08	5.24E-09	6.56E-08	6.43E-11	1.25E-07	1.84E-08	1.40E-07	7.81E-10	1.43E-09	2.18E-09	9.75E-09
White Matter	1.19E-06	8.75E-06	1.86E-06	9.16E-06	8.45E-07	1.87E-05	3.46E-06	1.93E-05	6.82E-07	8.19E-07	1.05E-06	2.19E-06

Table B.32: S values for the 5-year-old Phantom for Sources Located in the Cerebral Cortex.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.85E-05	8.17E-05	1.12E-04	5.13E-05	8.90E-05	3.97E-04	1.75E-04	1.96E-05	2.28E-05	1.18E-04	1.89E-04	3.34E-05
Caud. Nucl.	1.27E-05	1.28E-05	1.28E-05	1.28E-05	4.43E-08	1.51E-05	1.27E-05	2.35E-06	1.46E-06	2.84E-05	1.37E-05	3.21E-08
Cerebellum	1.46E-05	1.57E-05	1.98E-05	1.35E-05	6.34E-06	1.68E-04	3.60E-05	2.66E-06	1.65E-06	4.16E-05	4.25E-05	7.31E-07
Cereb. Cort.	1.44E-04	1.74E-04	2.41E-04	1.03E-04	2.08E-04	6.86E-04	3.70E-04	4.37E-05	5.33E-05	2.20E-04	3.92E-04	8.10E-05
Cranium	1.42E-05	1.61E-05	2.38E-05	1.30E-05	1.01E-05	2.66E-04	5.81E-05	2.47E-06	1.84E-06	5.25E-05	6.94E-05	3.99E-07
Eyes	7.38E-06	7.39E-06	7.42E-06	7.40E-06	3.00E-08	3.21E-05	7.91E-06	1.37E-06	7.88E-07	1.78E-05	9.09E-06	1.80E-08
Lent. Nucl.	1.23E-05	1.24E-05	1.24E-05	1.24E-05	5.36E-08	4.53E-05	1.32E-05	2.28E-06	1.48E-06	2.89E-05	1.50E-05	3.24E-08
Mandible	3.12E-06	3.12E-06	3.13E-06	3.12E-06	1.34E-08	6.86E-06	3.22E-06	5.77E-07	4.43E-07	7.44E-06	3.56E-06	8.52E-09
Other Tissues	3.38E-06	3.38E-06	3.39E-06	3.39E-06	1.23E-08	1.31E-05	3.65E-06	6.26E-07	3.68E-07	8.15E-06	4.17E-06	8.67E-09
Skin	6.14E-06	6.15E-06	6.18E-06	6.15E-06	3.60E-08	6.68E-05	8.65E-06	1.13E-06	6.17E-07	1.54E-05	1.09E-05	1.55E-08
Spinal Col.	2.51E-06	2.51E-06	2.52E-06	2.52E-06	4.76E-09	8.31E-06	2.66E-06	4.68E-07	3.22E-07	6.30E-06	3.02E-06	6.21E-09
Spinal Skel.	2.72E-06	2.73E-06	2.74E-06	2.73E-06	1.25E-08	6.95E-06	2.82E-06	5.03E-07	4.06E-07	6.22E-06	3.13E-06	7.73E-09
Thalami	1.24E-05	1.24E-05	1.24E-05	1.24E-05	4.37E-08	1.91E-05	1.24E-05	2.29E-06	1.49E-06	2.84E-05	1.35E-05	3.34E-08
Thyroid	1.03E-06	1.03E-06	1.03E-06	1.03E-06	4.57E-09	1.22E-06	1.02E-06	1.93E-07	1.04E-07	2.90E-06	1.13E-06	2.43E-09
Trunk	3.53E-08	3.54E-08	3.54E-08	3.54E-08	6.62E-11	3.98E-08	3.51E-08	6.64E-09	2.61E-09	1.14E-07	3.87E-08	8.69E-11
White Matter	1.81E-05	1.97E-05	2.50E-05	1.67E-05	8.41E-06	2.24E-04	4.67E-05	3.29E-06	2.08E-06	5.25E-05	5.53E-05	9.57E-07

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.33E-06	1.45E-04	7.78E-06	4.28E-05	5.22E-06	7.53E-05	3.23E-05	1.01E-04	1.95E-05	1.06E-05	7.97E-06	1.73E-05
Caud. Nucl.	1.61E-06	1.18E-05	2.52E-06	1.23E-05	1.14E-06	2.52E-05	4.73E-06	2.56E-05	9.46E-07	1.14E-06	1.46E-06	2.97E-06
Cerebellum	1.62E-06	3.18E-05	2.78E-06	1.50E-05	1.59E-06	2.73E-05	5.19E-06	3.07E-05	1.11E-06	1.16E-06	1.46E-06	3.06E-06
Cereb. Cort.	7.85E-06	3.03E-04	1.43E-05	7.96E-05	1.01E-05	1.39E-04	7.04E-05	1.96E-04	4.60E-05	2.40E-05	1.70E-05	3.72E-05
Cranium	2.17E-06	5.09E-05	5.09E-06	1.77E-05	4.93E-06	2.69E-05	5.14E-06	3.23E-05	2.70E-06	2.61E-06	3.03E-06	3.30E-06
Eyes	8.49E-07	7.39E-06	1.18E-06	7.24E-06	2.86E-07	1.51E-05	2.71E-06	1.56E-05	3.38E-07	4.84E-07	6.47E-07	1.67E-06
Lent. Nucl.	1.65E-06	1.23E-05	2.60E-06	1.23E-05	1.25E-06	2.50E-05	4.66E-06	2.57E-05	9.75E-07	1.16E-06	1.47E-06	2.96E-06
Mandible	5.24E-07	2.99E-06	6.78E-07	3.11E-06	2.06E-07	6.35E-06	1.20E-06	6.56E-06	2.79E-07	4.39E-07	5.41E-07	7.98E-07
Other Tissues	3.99E-07	3.40E-06	5.58E-07	3.34E-06	1.48E-07	6.92E-06	1.25E-06	7.17E-06	1.67E-07	2.36E-07	3.12E-07	7.71E-07
Skin	6.58E-07	8.10E-06	1.00E-06	5.92E-06	3.59E-07	1.23E-05	2.22E-06	1.26E-05	3.10E-07	3.82E-07	5.09E-07	1.35E-06
Spinal Col.	3.52E-07	2.48E-06	4.65E-07	2.59E-06	9.69E-08	5.23E-06	9.76E-07	5.50E-06	1.30E-07	1.95E-07	2.61E-07	6.37E-07
Spinal Skel.	4.83E-07	2.63E-06	6.44E-07	2.65E-06	2.33E-07	5.46E-06	1.06E-06	5.57E-06	2.85E-07	4.33E-07	5.27E-07	7.17E-07
Thalami	1.67E-06	1.16E-05	2.61E-06	1.23E-05	1.22E-06	2.52E-05	4.68E-06	2.59E-05	9.86E-07	1.17E-06	1.50E-06	2.97E-06
Thyroid	1.18E-07	9.58E-07	1.43E-07	1.19E-06	9.49E-09	2.38E-06	3.72E-07	2.65E-06	3.30E-08	5.72E-08	7.89E-08	2.18E-07
Trunk	2.72E-09	3.29E-08	3.56E-09	4.22E-08	7.90E-11	8.01E-08	1.20E-08	8.94E-08	5.69E-10	1.03E-09	1.54E-09	6.48E-09
White Matter	2.03E-06	4.12E-05	3.52E-06	1.87E-05	2.06E-06	3.38E-05	6.46E-06	3.82E-05	1.41E-06	1.47E-06	1.85E-06	3.82E-06

Table B.33: S values for the 5-year-old Phantom for Sources Located in the Cranial CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.57E-05	3.17E-05	4.68E-05	1.87E-05	3.17E-05	2.24E-04	8.21E-05	4.98E-06	3.49E-06	6.30E-05	9.07E-05	6.43E-06
Caud. Nucl.	9.44E-06	9.45E-06	9.47E-06	9.46E-06	3.01E-08	1.05E-05	9.39E-06	1.75E-06	1.09E-06	2.12E-05	1.01E-05	2.58E-08
Cerebellum	3.14E-05	3.97E-05	6.00E-05	2.20E-05	4.29E-05	2.91E-04	1.07E-04	6.11E-06	4.32E-06	7.69E-05	1.18E-04	8.67E-06
Cereb. Cort.	4.24E-05	5.52E-05	8.72E-05	2.76E-05	6.72E-05	4.02E-04	1.61E-04	8.34E-06	6.05E-06	1.05E-04	1.77E-04	1.36E-05
Cranium	7.88E-05	1.08E-04	1.80E-04	4.57E-05	1.51E-04	5.86E-04	3.25E-04	1.56E-05	1.22E-05	1.85E-04	3.49E-04	3.02E-05
Eyes	7.40E-06	7.41E-06	7.47E-06	7.41E-06	5.86E-08	5.85E-05	9.38E-06	1.37E-06	8.45E-07	1.93E-05	1.14E-05	2.10E-08
Lent. Nucl.	9.75E-06	9.76E-06	9.78E-06	9.76E-06	3.13E-08	1.97E-05	9.88E-06	1.80E-06	1.14E-06	2.25E-05	1.09E-05	2.57E-08
Mandible	3.35E-06	3.36E-06	3.40E-06	3.36E-06	4.33E-08	1.22E-05	3.89E-06	6.21E-07	4.63E-07	8.24E-06	4.43E-06	9.15E-09
Other Tissues	4.01E-06	4.02E-06	4.10E-06	4.02E-06	7.64E-08	3.37E-05	6.03E-06	7.43E-07	4.25E-07	1.07E-05	7.36E-06	1.04E-08
Skin	7.20E-06	7.23E-06	8.16E-06	7.21E-06	8.30E-07	1.37E-04	2.61E-05	1.33E-06	7.27E-07	2.65E-05	3.31E-05	1.86E-08
Spinal Col.	3.29E-06	3.29E-06	3.34E-06	3.30E-06	4.36E-08	2.62E-05	4.64E-06	6.11E-07	3.85E-07	8.84E-06	5.64E-06	8.19E-09
Spinal Skel.	3.47E-06	3.48E-06	3.51E-06	3.48E-06	3.51E-08	2.16E-05	4.48E-06	6.42E-07	4.86E-07	8.52E-06	5.32E-06	9.88E-09
Thalami	9.59E-06	9.60E-06	9.63E-06	9.61E-06	3.35E-08	1.09E-05	9.55E-06	1.78E-06	1.12E-06	2.19E-05	1.03E-05	2.50E-08
Thyroid	1.16E-06	1.17E-06	1.17E-06	1.17E-06	2.45E-09	1.28E-06	1.15E-06	2.19E-07	1.34E-07	3.30E-06	1.26E-06	2.69E-09
Trunk	3.65E-08	3.65E-08	3.66E-08	3.66E-08	6.88E-11	4.06E-08	3.63E-08	6.85E-09	2.63E-09	1.14E-07	3.98E-08	8.55E-11
White Matter	1.08E-05	1.08E-05	1.09E-05	1.08E-05	3.95E-08	6.90E-05	1.20E-05	2.00E-06	1.22E-06	2.60E-05	1.42E-05	2.91E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.65E-06	6.90E-05	2.88E-06	2.21E-05	1.63E-06	3.50E-05	8.49E-06	4.70E-05	1.88E-06	1.35E-06	1.61E-06	3.68E-06
Caud. Nucl.	1.20E-06	8.71E-06	1.78E-06	9.19E-06	6.83E-07	1.91E-05	3.52E-06	1.96E-05	6.28E-07	8.06E-07	1.04E-06	2.21E-06
Cerebellum	1.82E-06	8.95E-05	3.25E-06	2.65E-05	1.92E-06	4.05E-05	1.02E-05	5.64E-05	2.30E-06	1.55E-06	1.82E-06	4.19E-06
Cereb. Cort.	2.01E-06	1.34E-04	3.69E-06	3.48E-05	2.26E-06	4.98E-05	1.35E-05	7.47E-05	3.11E-06	1.85E-06	2.12E-06	5.02E-06
Cranium	3.40E-06	2.68E-04	8.53E-06	6.36E-05	8.38E-06	7.93E-05	2.46E-05	1.34E-04	8.20E-06	4.90E-06	5.31E-06	8.01E-06
Eyes	8.99E-07	8.78E-06	1.25E-06	7.45E-06	2.94E-07	1.55E-05	2.80E-06	1.63E-05	3.49E-07	5.07E-07	6.80E-07	1.76E-06
Lent. Nucl.	1.25E-06	9.22E-06	1.93E-06	9.68E-06	8.30E-07	2.01E-05	3.67E-06	2.08E-05	6.88E-07	8.42E-07	1.08E-06	2.32E-06
Mandible	5.45E-07	3.60E-06	7.21E-07	3.37E-06	2.35E-07	6.88E-06	1.28E-06	7.14E-06	2.98E-07	4.58E-07	5.64E-07	8.45E-07
Other Tissues	4.59E-07	5.57E-06	6.58E-07	4.03E-06	1.93E-07	8.20E-06	1.47E-06	8.56E-06	1.99E-07	2.71E-07	3.59E-07	9.01E-07
Skin	7.73E-07	2.33E-05	1.20E-06	7.67E-06	4.50E-07	1.45E-05	2.62E-06	1.57E-05	3.66E-07	4.43E-07	5.92E-07	1.59E-06
Spinal Col.	4.17E-07	4.30E-06	5.69E-07	3.35E-06	1.33E-07	6.66E-06	1.24E-06	6.94E-06	1.57E-07	2.20E-07	2.99E-07	7.92E-07
Spinal Skel.	5.69E-07	4.16E-06	8.01E-07	3.43E-06	3.32E-07	6.97E-06	1.33E-06	7.15E-06	3.61E-07	5.28E-07	6.41E-07	8.84E-07
Thalami	1.22E-06	8.86E-06	1.85E-06	9.46E-06	7.45E-07	1.93E-05	3.59E-06	1.98E-05	6.63E-07	8.40E-07	1.08E-06	2.27E-06
Thyroid	1.43E-07	1.08E-06	1.79E-07	1.32E-06	1.45E-08	2.54E-06	4.41E-07	2.77E-06	4.10E-08	7.24E-08	9.95E-08	2.77E-07
Trunk	2.77E-09	3.39E-08	3.60E-09	4.26E-08	7.65E-11	8.16E-08	1.23E-08	9.04E-08	6.00E-10	1.11E-09	1.62E-09	6.57E-09
White Matter	1.34E-06	1.13E-05	2.19E-06	1.08E-05	1.09E-06	2.19E-05	4.03E-06	2.26E-05	7.90E-07	9.04E-07	1.16E-06	2.51E-06

Table B.34: S values for the 5-year-old Phantom for Sources Located in the Cranium.

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	4.83E-06	7.95E-10	3.27E-06	6.38E-08	1.16E-05	1.35E-06	5.69E-07	4.26E-06	1.03E-06	9.15E-07	7.77E-06	7.23E-08
Caud. Nucl.	2.88E-08	2.20E-10	2.20E-08	2.01E-09	5.44E-08	1.11E-06	3.43E-07	3.18E-06	7.02E-07	2.04E-07	5.19E-07	5.75E-08
Cerebellum	6.24E-06	9.73E-10	4.21E-06	7.55E-08	1.50E-05	1.44E-06	6.53E-07	4.60E-06	1.13E-06	1.11E-06	9.93E-06	7.71E-08
Cereb. Cort.	1.03E-05	1.26E-09	6.95E-06	1.34E-07	2.46E-05	1.52E-06	7.03E-07	4.93E-06	1.31E-06	1.71E-06	1.59E-05	8.23E-08
Cranium	3.52E-04	4.81E-05	3.05E-04	1.18E-04	4.20E-04	1.32E-05	8.87E-06	1.25E-04	1.67E-04	1.99E-04	3.80E-04	2.90E-03
Eyes	5.94E-07	3.96E-10	3.59E-07	3.47E-09	2.18E-06	8.85E-07	1.91E-07	2.89E-06	4.67E-07	1.97E-07	1.54E-06	4.75E-08
Lent. Nucl.	3.75E-08	4.01E-10	2.88E-08	3.10E-09	7.11E-08	1.17E-06	3.68E-07	3.39E-06	7.55E-07	2.20E-07	5.60E-07	6.08E-08
Mandible	5.40E-07	3.11E-09	3.93E-07	3.38E-08	1.12E-06	5.59E-07	1.69E-07	1.32E-06	4.66E-07	2.37E-07	9.53E-07	2.63E-08
Other Tissues	3.06E-06	2.03E-08	2.26E-06	2.06E-07	5.83E-06	4.83E-07	1.39E-07	1.73E-06	5.79E-07	8.26E-07	4.23E-06	2.71E-08
Skin	4.13E-05	3.88E-07	3.23E-05	4.09E-06	6.28E-05	9.70E-07	3.63E-07	6.98E-06	6.42E-06	1.30E-05	4.88E-05	7.53E-08
Spinal Col.	2.02E-06	1.24E-08	1.48E-06	1.33E-07	4.01E-06	4.39E-07	9.13E-08	1.50E-06	4.13E-07	5.52E-07	2.90E-06	2.43E-08
Spinal Skel.	1.52E-06	9.32E-09	1.11E-06	9.02E-08	3.03E-06	6.02E-07	2.52E-07	1.43E-06	6.48E-07	4.75E-07	2.27E-06	2.87E-08
Thalami	3.78E-08	1.93E-10	2.83E-08	3.15E-09	6.69E-08	1.13E-06	3.41E-07	3.29E-06	7.13E-07	2.11E-07	5.42E-07	5.94E-08
Thyroid	6.62E-09	2.45E-11	4.38E-09	4.12E-10	1.27E-08	1.34E-07	8.52E-09	4.18E-07	6.01E-08	2.28E-08	7.46E-08	7.05E-09
Trunk	8.14E-11	8.28E-13	6.03E-11	6.33E-12	1.82E-10	2.72E-09	5.67E-11	1.21E-08	9.41E-10	4.19E-10	1.90E-09	1.55E-10
White Matter	3.95E-08	3.77E-10	3.06E-08	3.22E-09	1.06E-07	1.20E-06	4.53E-07	3.69E-06	7.85E-07	2.24E-07	5.97E-07	6.38E-08

Table B.35: S values for the 5-year-old Phantom for Sources Located in the Lateral Ventricles.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.86E-05	9.25E-05	1.25E-04	6.08E-05	9.28E-05	5.10E-04	1.99E-04	2.15E-05	2.41E-05	1.46E-04	2.17E-04	3.39E-05
Caud. Nucl.	6.53E-05	6.61E-05	7.51E-05	6.50E-05	9.04E-06	1.83E-03	1.83E-04	1.21E-05	7.37E-06	2.23E-04	2.44E-04	2.35E-07
Cerebellum	1.09E-05	1.09E-05	1.09E-05	1.09E-05	3.67E-08	1.23E-05	1.08E-05	2.01E-06	1.30E-06	2.48E-05	1.17E-05	2.91E-08
Cereb. Cort.	1.53E-05	1.53E-05	1.57E-05	1.53E-05	3.59E-07	8.81E-05	1.91E-05	2.83E-06	1.78E-06	3.73E-05	2.24E-05	4.37E-08
Cranium	8.08E-06	8.10E-06	8.13E-06	8.09E-06	4.45E-08	9.05E-06	8.08E-06	1.50E-06	1.32E-06	1.85E-05	8.71E-06	2.50E-08
Eyes	6.03E-06	6.03E-06	6.05E-06	6.04E-06	1.66E-08	6.64E-06	5.99E-06	1.12E-06	6.88E-07	1.40E-05	6.49E-06	1.50E-08
Lent. Nucl.	4.23E-05	4.27E-05	4.55E-05	4.22E-05	3.03E-06	4.62E-04	7.12E-05	7.79E-06	4.93E-06	1.13E-04	8.76E-05	1.39E-07
Mandible	3.20E-06	3.21E-06	3.22E-06	3.21E-06	1.22E-08	3.55E-06	3.19E-06	5.93E-07	4.87E-07	7.44E-06	3.44E-06	8.48E-09
Other Tissues	3.22E-06	3.23E-06	3.24E-06	3.23E-06	9.26E-09	3.56E-06	3.20E-06	5.97E-07	3.63E-07	7.49E-06	3.46E-06	8.25E-09
Skin	4.31E-06	4.32E-06	4.33E-06	4.32E-06	1.16E-08	4.73E-06	4.28E-06	7.98E-07	4.53E-07	9.82E-06	4.62E-06	1.11E-08
Spinal Col.	2.57E-06	2.57E-06	2.57E-06	2.57E-06	4.68E-09	2.85E-06	2.55E-06	4.76E-07	2.85E-07	6.08E-06	2.76E-06	5.91E-09
Spinal Skel.	2.42E-06	2.42E-06	2.43E-06	2.42E-06	1.14E-08	2.71E-06	2.41E-06	4.47E-07	4.01E-07	5.47E-06	2.60E-06	7.14E-09
Thalami	5.62E-05	5.73E-05	6.33E-05	5.57E-05	7.03E-06	8.47E-04	1.10E-04	1.03E-05	6.61E-06	1.61E-04	1.39E-04	3.00E-07
Thyroid	1.51E-06	1.51E-06	1.51E-06	1.51E-06	3.20E-09	1.66E-06	1.50E-06	2.80E-07	1.24E-07	3.44E-06	1.62E-06	3.34E-09
Trunk	4.34E-08	4.35E-08	4.35E-08	4.35E-08	6.71E-11	4.89E-08	4.32E-08	8.16E-09	3.10E-09	1.44E-07	4.76E-08	1.02E-10
White Matter	3.80E-05	4.27E-05	5.85E-05	3.39E-05	2.50E-05	5.19E-04	1.17E-04	6.88E-06	4.47E-06	1.15E-04	1.37E-04	2.92E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.60E-06	1.66E-04	1.01E-05	5.32E-05	6.68E-06	9.44E-05	3.60E-05	1.22E-04	2.04E-05	1.16E-05	9.20E-06	1.95E-05
Caud. Nucl.	8.35E-06	1.69E-04	1.62E-05	7.12E-05	1.17E-05	1.31E-04	2.44E-05	1.40E-04	6.31E-06	6.19E-06	7.76E-06	1.53E-05
Cerebellum	1.43E-06	1.00E-05	2.19E-06	1.07E-05	9.35E-07	2.20E-05	4.09E-06	2.27E-05	8.13E-07	1.01E-06	1.29E-06	2.60E-06
Cereb. Cort.	1.97E-06	1.78E-05	3.24E-06	1.53E-05	1.67E-06	3.09E-05	5.74E-06	3.19E-05	1.22E-06	1.40E-06	1.78E-06	3.63E-06
Cranium	1.57E-06	7.61E-06	2.57E-06	8.35E-06	1.63E-06	1.64E-05	3.24E-06	1.68E-05	1.41E-06	1.79E-06	2.11E-06	2.25E-06
Eyes	7.38E-07	5.54E-06	9.73E-07	5.93E-06	1.66E-07	1.26E-05	2.27E-06	1.31E-05	2.66E-07	4.22E-07	5.64E-07	1.43E-06
Lent. Nucl.	5.51E-06	6.58E-05	1.01E-05	4.38E-05	6.52E-06	8.54E-05	1.59E-05	8.93E-05	3.95E-06	4.03E-06	5.09E-06	1.00E-05
Mandible	5.80E-07	2.94E-06	6.94E-07	3.13E-06	1.40E-07	6.47E-06	1.26E-06	6.64E-06	2.69E-07	4.64E-07	5.75E-07	8.56E-07
Other Tissues	3.97E-07	2.96E-06	5.17E-07	3.15E-06	9.04E-08	6.56E-06	1.20E-06	6.78E-06	1.48E-07	2.35E-07	3.11E-07	7.48E-07
Skin	4.86E-07	3.95E-06	6.60E-07	4.16E-06	1.37E-07	8.75E-06	1.58E-06	9.01E-06	1.88E-07	2.83E-07	3.77E-07	9.67E-07
Spinal Col.	3.14E-07	2.36E-06	3.97E-07	2.55E-06	5.33E-08	5.35E-06	9.47E-07	5.58E-06	1.08E-07	1.82E-07	2.42E-07	5.86E-07
Spinal Skel.	4.86E-07	2.23E-06	5.78E-07	2.33E-06	1.32E-07	4.83E-06	9.67E-07	4.92E-06	2.43E-07	4.17E-07	5.10E-07	6.77E-07
Thalami	7.40E-06	1.02E-04	1.39E-05	5.96E-05	9.53E-06	1.14E-04	2.12E-05	1.21E-04	5.46E-06	5.37E-06	6.78E-06	1.34E-05
Thyroid	1.39E-07	1.38E-06	1.73E-07	1.46E-06	1.39E-08	3.03E-06	5.07E-07	3.14E-06	4.40E-08	7.93E-08	1.05E-07	2.83E-07
Trunk	3.22E-09	4.05E-08	4.23E-09	5.26E-08	8.28E-11	9.91E-08	1.47E-08	1.11E-07	6.82E-10	1.26E-09	1.86E-09	7.79E-09
White Matter	4.11E-06	1.02E-04	7.43E-06	3.96E-05	4.74E-06	6.80E-05	1.34E-05	7.99E-05	3.19E-06	3.15E-06	3.90E-06	7.71E-06

Table B.36: S values for the 5-year-old Phantom for Sources Located in the Lentiform Nuclei.

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.60E-05	9.00E-05	1.22E-04	5.82E-05	9.28E-05	5.06E-04	1.96E-04	2.10E-05	2.38E-05	1.41E-04	2.14E-04	3.39E-05
Caud. Nucl.	1.55E-04	1.97E-04	3.39E-04	1.16E-04	2.26E-04	3.93E-03	8.54E-04	2.74E-05	1.82E-05	5.97E-04	1.01E-03	2.63E-05
Cerebellum	7.12E-06	7.13E-06	7.15E-06	7.13E-06	2.26E-08	7.87E-06	7.08E-06	1.32E-06	8.56E-07	1.64E-05	7.64E-06	1.89E-08
Cereb. Cort.	1.24E-05	1.24E-05	1.24E-05	1.24E-05	5.32E-08	4.48E-05	1.32E-05	2.29E-06	1.46E-06	2.89E-05	1.50E-05	3.33E-08
Cranium	8.99E-06	9.01E-06	9.04E-06	9.00E-06	5.28E-08	1.36E-05	9.06E-06	1.66E-06	1.47E-06	2.06E-05	9.85E-06	2.91E-08
Eyes	9.82E-06	9.83E-06	9.86E-06	9.84E-06	3.02E-08	1.09E-05	9.76E-06	1.82E-06	1.09E-06	2.26E-05	1.05E-05	2.56E-08
Lent. Nucl.	3.92E-03	4.80E-03	6.66E-03	2.73E-03	6.06E-03	1.59E-02	1.00E-02	1.25E-03	1.57E-03	5.38E-03	1.05E-02	2.43E-03
Mandible	5.97E-06	5.98E-06	5.99E-06	5.98E-06	2.53E-08	6.65E-06	5.95E-06	1.11E-06	9.26E-07	1.37E-05	6.42E-06	1.70E-08
Other Tissues	5.20E-06	5.20E-06	5.22E-06	5.21E-06	1.55E-08	5.82E-06	5.17E-06	9.62E-07	6.00E-07	1.19E-05	5.58E-06	1.33E-08
Skin	4.25E-06	4.25E-06	4.26E-06	4.26E-06	1.12E-08	4.68E-06	4.22E-06	7.86E-07	4.49E-07	9.70E-06	4.56E-06	1.09E-08
Spinal Col.	2.43E-06	2.44E-06	2.44E-06	2.44E-06	8.53E-09	2.67E-06	2.41E-06	4.50E-07	3.11E-07	5.54E-06	2.61E-06	8.33E-09
Spinal Skel.	2.61E-06	2.62E-06	2.63E-06	2.62E-06	1.36E-08	2.90E-06	2.61E-06	4.83E-07	4.81E-07	5.85E-06	2.81E-06	7.92E-09
Thalami	1.65E-04	2.07E-04	3.43E-04	1.28E-04	2.19E-04	4.09E-03	8.46E-04	2.95E-05	1.94E-05	6.15E-04	1.00E-03	2.59E-05
Thyroid	2.19E-06	2.19E-06	2.19E-06	2.19E-06	6.51E-09	2.37E-06	2.17E-06	4.04E-07	1.99E-07	5.12E-06	2.35E-06	4.96E-09
Trunk	5.39E-08	5.40E-08	5.41E-08	5.40E-08	1.12E-10	6.02E-08	5.36E-08	1.01E-08	4.23E-09	1.66E-07	5.89E-08	1.29E-10
White Matter	3.23E-05	3.56E-05	4.67E-05	2.95E-05	1.75E-05	4.37E-04	9.00E-05	5.87E-06	3.81E-06	9.54E-05	1.07E-04	2.05E-06

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.27E-06	1.64E-04	9.45E-06	5.06E-05	6.30E-06	8.91E-05	3.50E-05	1.17E-04	2.02E-05	1.13E-05	8.87E-06	1.89E-05
Caud. Nucl.	1.23E-05	7.31E-04	2.48E-05	1.69E-04	1.88E-05	2.32E-04	4.94E-05	3.30E-04	1.23E-05	1.06E-05	1.25E-05	2.45E-05
Cerebellum	9.44E-07	6.56E-06	1.34E-06	6.99E-06	4.38E-07	1.44E-05	2.69E-06	1.48E-05	4.66E-07	6.40E-07	8.23E-07	1.71E-06
Cereb. Cort.	1.61E-06	1.24E-05	2.57E-06	1.23E-05	1.22E-06	2.50E-05	4.67E-06	2.57E-05	9.48E-07	1.12E-06	1.43E-06	2.96E-06
Cranium	1.76E-06	8.60E-06	3.16E-06	9.48E-06	2.32E-06	1.82E-05	3.63E-06	1.87E-05	1.73E-06	2.01E-06	2.37E-06	2.51E-06
Eyes	1.18E-06	9.00E-06	1.53E-06	9.56E-06	2.50E-07	1.98E-05	3.62E-06	2.04E-05	4.23E-07	6.82E-07	9.08E-07	2.26E-06
Lent. Nucl.	1.93E-04	8.13E-03	3.55E-04	1.96E-03	2.61E-04	3.41E-03	1.99E-03	5.03E-03	1.37E-03	7.00E-04	4.78E-04	1.04E-03
Mandible	1.11E-06	5.52E-06	1.44E-06	5.91E-06	4.92E-07	1.21E-05	2.35E-06	1.25E-05	6.39E-07	9.89E-07	1.20E-06	1.61E-06
Other Tissues	6.58E-07	4.78E-06	8.99E-07	5.08E-06	2.31E-07	1.06E-05	1.94E-06	1.09E-05	2.81E-07	4.06E-07	5.33E-07	1.22E-06
Skin	4.83E-07	3.89E-06	6.43E-07	4.10E-06	1.14E-07	8.64E-06	1.56E-06	8.90E-06	1.74E-07	2.70E-07	3.62E-07	9.55E-07
Spinal Col.	3.38E-07	2.23E-06	4.29E-07	2.35E-06	6.33E-08	5.06E-06	9.42E-07	5.24E-06	1.20E-07	1.99E-07	2.64E-07	6.14E-07
Spinal Skel.	5.87E-07	2.41E-06	7.03E-07	2.52E-06	1.81E-07	5.25E-06	1.08E-06	5.34E-06	3.08E-07	5.20E-07	6.33E-07	7.84E-07
Thalami	1.37E-05	7.26E-04	2.76E-05	1.78E-04	2.09E-05	2.54E-04	5.35E-05	3.48E-04	1.35E-05	1.14E-05	1.37E-05	2.71E-05
Thyroid	2.14E-07	2.00E-06	2.88E-07	2.13E-06	5.15E-08	4.54E-06	7.66E-07	4.72E-06	8.24E-08	1.33E-07	1.74E-07	4.45E-07
Trunk	4.46E-09	5.01E-08	5.73E-09	6.23E-08	1.53E-10	1.20E-07	1.85E-08	1.33E-07	1.02E-09	1.89E-09	2.73E-09	1.02E-08
White Matter	3.64E-06	7.91E-05	6.52E-06	3.36E-05	4.09E-06	5.92E-05	1.15E-05	6.78E-05	2.72E-06	2.73E-06	3.40E-06	6.78E-06

Table B.37: S values for the 5-year-old Phantom for Sources Located in the Spinal CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	3.68E-06	3.68E-06	3.69E-06	3.69E-06	1.04E-08	7.67E-06	3.76E-06	6.81E-07	4.06E-07	8.69E-06	4.14E-06	9.38E-09
Caud. Nucl.	3.09E-06	3.10E-06	3.11E-06	3.10E-06	8.78E-09	3.38E-06	3.08E-06	5.71E-07	3.26E-07	7.01E-06	3.31E-06	7.47E-09
Cerebellum	6.75E-06	6.76E-06	6.78E-06	6.76E-06	2.07E-08	1.75E-05	7.01E-06	1.25E-06	7.46E-07	1.59E-05	7.81E-06	1.74E-08
Cereb. Cort.	3.39E-06	3.40E-06	3.40E-06	3.40E-06	9.65E-09	1.00E-05	3.54E-06	6.29E-07	3.69E-07	8.13E-06	3.97E-06	8.63E-09
Cranium	4.75E-06	5.11E-06	6.34E-06	4.44E-06	1.93E-06	3.65E-05	1.08E-05	8.67E-07	6.84E-07	1.31E-05	1.24E-05	2.24E-07
Eyes	1.45E-06	1.46E-06	1.46E-06	1.46E-06	3.87E-09	1.61E-06	1.45E-06	2.70E-07	1.47E-07	3.84E-06	1.57E-06	3.46E-09
Lent. Nucl.	4.00E-06	4.00E-06	4.01E-06	4.00E-06	1.02E-08	4.36E-06	3.98E-06	7.40E-07	4.89E-07	9.16E-06	4.29E-06	1.03E-08
Mandible	3.97E-06	3.97E-06	3.98E-06	3.97E-06	1.64E-08	4.45E-06	3.95E-06	7.34E-07	5.93E-07	9.23E-06	4.27E-06	1.09E-08
Other Tissues	1.15E-05	1.15E-05	1.16E-05	1.16E-05	3.42E-08	1.63E-05	1.15E-05	2.13E-06	1.27E-06	2.67E-05	1.25E-05	2.96E-08
Skin	4.35E-06	4.36E-06	4.37E-06	4.36E-06	1.30E-08	4.83E-06	4.33E-06	8.05E-07	4.55E-07	9.87E-06	4.67E-06	1.11E-08
Spinal Col.	6.84E-04	1.01E-03	2.07E-03	3.95E-04	1.70E-03	1.23E-02	5.29E-03	1.17E-04	8.16E-05	2.90E-03	5.94E-03	1.93E-04
Spinal Skel.	1.21E-04	1.47E-04	2.34E-04	9.76E-05	1.38E-04	2.69E-03	5.54E-04	2.14E-05	1.61E-05	4.31E-04	6.57E-04	1.55E-05
Thalami	5.72E-06	5.72E-06	5.73E-06	5.73E-06	1.53E-08	6.35E-06	5.68E-06	1.06E-06	6.74E-07	1.32E-05	6.13E-06	1.44E-08
Thyroid	1.86E-05	1.86E-05	1.86E-05	1.86E-05	4.47E-08	2.01E-05	1.85E-05	3.45E-06	2.20E-06	4.33E-05	1.99E-05	4.76E-08
Trunk	7.36E-07	7.44E-07	7.74E-07	7.30E-07	4.51E-08	2.01E-06	8.83E-07	1.36E-07	7.61E-08	1.89E-06	9.85E-07	6.55E-09
White Matter	3.21E-06	3.21E-06	3.22E-06	3.21E-06	8.77E-09	3.60E-06	3.19E-06	5.94E-07	3.56E-07	7.50E-06	3.45E-06	8.16E-09

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.43E-07	3.48E-06	5.78E-07	3.60E-06	9.82E-08	7.50E-06	1.36E-06	7.76E-06	1.57E-07	2.48E-07	3.33E-07	8.44E-07
Caud. Nucl.	3.66E-07	2.83E-06	4.52E-07	2.92E-06	4.88E-08	6.09E-06	1.11E-06	6.19E-06	1.16E-07	1.94E-07	2.62E-07	6.78E-07
Cerebellum	8.12E-07	6.50E-06	1.10E-06	6.61E-06	2.40E-07	1.37E-05	2.50E-06	1.42E-05	3.17E-07	4.74E-07	6.30E-07	1.55E-06
Cereb. Cort.	4.01E-07	3.29E-06	5.29E-07	3.34E-06	9.56E-08	6.93E-06	1.25E-06	7.18E-06	1.43E-07	2.22E-07	2.98E-07	7.73E-07
Cranium	7.43E-07	9.48E-06	1.12E-06	4.92E-06	5.85E-07	8.94E-06	1.77E-06	9.98E-06	5.33E-07	7.06E-07	8.48E-07	1.13E-06
Eyes	1.56E-07	1.34E-06	1.92E-07	1.52E-06	2.17E-09	3.03E-06	5.29E-07	3.20E-06	3.15E-08	5.77E-08	8.66E-08	3.20E-07
Lent. Nucl.	5.28E-07	3.66E-06	6.65E-07	3.86E-06	7.83E-08	8.05E-06	1.53E-06	8.26E-06	1.71E-07	2.90E-07	3.91E-07	9.88E-07
Mandible	7.06E-07	3.65E-06	8.16E-07	3.87E-06	1.19E-07	8.06E-06	1.55E-06	8.30E-06	3.03E-07	5.53E-07	6.88E-07	1.05E-06
Other Tissues	1.37E-06	1.07E-05	1.85E-06	1.13E-05	3.93E-07	2.34E-05	4.26E-06	2.42E-05	5.39E-07	8.12E-07	1.08E-06	2.65E-06
Skin	4.81E-07	3.99E-06	6.42E-07	4.19E-06	1.02E-07	8.82E-06	1.59E-06	9.07E-06	1.62E-07	2.54E-07	3.46E-07	9.80E-07
Spinal Col.	3.07E-05	4.40E-03	6.36E-05	7.73E-04	4.99E-05	7.81E-04	1.90E-04	1.48E-03	4.46E-05	3.35E-05	3.67E-05	7.14E-05
Spinal Skel.	1.42E-05	4.79E-04	3.34E-05	1.37E-04	3.20E-05	1.96E-04	4.13E-05	2.57E-04	1.92E-05	1.74E-05	2.00E-05	2.32E-05
Thalami	7.43E-07	5.24E-06	9.45E-07	5.53E-06	1.43E-07	1.16E-05	2.15E-06	1.19E-05	2.61E-07	4.27E-07	5.68E-07	1.36E-06
Thyroid	2.37E-06	1.71E-05	3.29E-06	1.84E-05	8.54E-07	3.81E-05	7.06E-06	3.94E-05	1.01E-06	1.45E-06	1.91E-06	4.51E-06
Trunk	8.10E-08	8.07E-07	1.10E-07	7.53E-07	2.27E-08	1.52E-06	2.66E-07	1.61E-06	3.04E-08	4.55E-08	6.09E-08	1.60E-07
White Matter	3.90E-07	2.94E-06	4.98E-07	3.13E-06	6.98E-08	6.54E-06	1.19E-06	6.77E-06	1.32E-07	2.17E-07	2.91E-07	7.37E-07

Table B.38: S values for the 5-year-old Phantom for Sources Located in the Spinal Skeleton.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	1.25E-08	5.93E-11	9.47E-09	8.68E-10	3.43E-08	4.31E-07	4.77E-08	1.33E-06	2.07E-07	7.38E-08	2.15E-07	2.29E-08
Caud. Nucl.	1.18E-08	9.21E-11	9.46E-09	7.71E-10	1.73E-08	3.78E-07	2.37E-08	1.14E-06	1.61E-07	6.22E-08	1.80E-07	2.00E-08
Cerebellum	2.55E-08	1.18E-10	1.92E-08	1.81E-09	9.10E-08	8.00E-07	1.11E-07	2.49E-06	4.01E-07	1.39E-07	4.07E-07	4.27E-08
Cereb. Cort.	1.14E-08	3.44E-11	8.51E-09	6.85E-10	3.67E-08	3.88E-07	4.51E-08	1.22E-06	1.85E-07	6.60E-08	1.97E-07	2.07E-08
Cranium	1.55E-06	8.85E-09	1.13E-06	9.42E-08	3.07E-06	7.22E-07	2.74E-07	1.69E-06	7.42E-07	5.08E-07	2.35E-06	3.41E-08
Eyes	5.41E-09	3.93E-11	4.11E-09	3.74E-10	8.54E-09	1.45E-07	1.29E-09	5.12E-07	5.07E-08	2.26E-08	8.06E-08	7.84E-09
Lent. Nucl.	1.25E-08	1.16E-11	9.84E-09	7.55E-10	2.37E-08	5.06E-07	4.24E-08	1.49E-06	2.43E-07	8.73E-08	2.42E-07	4.61E-02
Mandible	1.91E-08	1.69E-10	1.48E-08	1.82E-09	3.34E-08	6.97E-07	9.53E-08	1.56E-06	4.64E-07	1.41E-07	2.88E-07	3.23E-08
Other Tissues	3.57E-06	2.12E-08	2.60E-06	2.23E-07	7.28E-06	1.51E-06	3.91E-07	4.90E-06	1.19E-06	1.09E-06	5.50E-06	8.17E-08
Skin	1.45E-08	8.21E-11	1.10E-08	8.30E-10	3.36E-08	4.95E-07	9.22E-08	1.67E-06	2.49E-07	8.43E-08	2.56E-07	2.70E-08
Spinal Col.	3.67E-06	4.61E-09	1.74E-06	3.08E-08	3.15E-05	9.34E-06	4.18E-06	2.91E-05	6.09E-06	1.70E-06	1.63E-05	5.07E-07
Spinal Skel.	8.77E-04	1.03E-04	7.43E-04	2.61E-04	1.14E-03	3.62E-05	2.71E-05	2.92E-04	3.78E-04	4.57E-04	9.82E-04	5.45E-06
Thalami	1.76E-08	9.73E-11	1.40E-08	1.86E-09	3.23E-08	7.04E-07	7.79E-08	2.14E-06	3.53E-07	1.23E-07	3.35E-07	3.69E-08
Thyroid	6.06E-08	6.93E-10	4.79E-08	4.94E-09	1.13E-07	2.47E-06	6.03E-07	7.17E-06	1.43E-06	4.42E-07	1.14E-06	1.29E-07
Trunk	3.55E-08	2.05E-10	2.59E-08	2.19E-09	7.33E-08	7.54E-08	1.04E-08	2.50E-07	4.00E-08	2.06E-08	8.48E-08	4.05E-09
White Matter	1.06E-08	7.01E-11	8.08E-09	8.08E-10	2.02E-08	3.79E-07	3.59E-08	1.16E-06	1.80E-07	6.48E-08	1.85E-07	2.00E-08

Table B.39: S values for the 5-year-old Phantom for Sources Located in the Thalami.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.72E-05	9.11E-05	1.24E-04	5.93E-05	9.28E-05	5.09E-04	1.97E-04	2.12E-05	2.39E-05	1.43E-04	2.15E-04	3.39E-05
Caud. Nucl.	6.19E-05	6.58E-05	8.47E-05	5.94E-05	2.36E-05	1.50E-03	2.02E-04	1.12E-05	6.78E-06	2.14E-04	2.56E-04	1.04E-06
Cerebellum	1.08E-05	1.08E-05	1.08E-05	1.08E-05	3.58E-08	1.19E-05	1.07E-05	1.99E-06	1.32E-06	2.46E-05	1.16E-05	2.87E-08
Cereb. Cort.	1.24E-05	1.24E-05	1.25E-05	1.24E-05	4.42E-08	1.91E-05	1.25E-05	2.30E-06	1.49E-06	2.84E-05	1.36E-05	3.37E-08
Cranium	8.64E-06	8.65E-06	8.68E-06	8.65E-06	5.16E-08	9.77E-06	8.63E-06	1.60E-06	1.43E-06	1.98E-05	9.32E-06	2.80E-08
Eyes	6.87E-06	6.87E-06	6.89E-06	6.88E-06	1.88E-08	7.44E-06	6.82E-06	1.27E-06	7.63E-07	1.55E-05	7.35E-06	1.81E-08
Lent. Nucl.	1.63E-04	2.05E-04	3.40E-04	1.26E-04	2.18E-04	4.09E-03	8.44E-04	2.91E-05	1.92E-05	6.15E-04	1.00E-03	2.56E-05
Mandible	5.28E-06	5.29E-06	5.30E-06	5.29E-06	2.30E-08	5.86E-06	5.26E-06	9.76E-07	8.41E-07	1.20E-05	5.67E-06	1.54E-08
Other Tissues	5.50E-06	5.51E-06	5.52E-06	5.51E-06	1.65E-08	6.07E-06	5.47E-06	1.02E-06	6.39E-07	1.26E-05	5.90E-06	1.43E-08
Skin	4.11E-06	4.12E-06	4.12E-06	4.12E-06	9.62E-09	4.53E-06	4.08E-06	7.61E-07	4.36E-07	9.39E-06	4.41E-06	1.03E-08
Spinal Col.	3.73E-06	3.74E-06	3.75E-06	3.74E-06	1.08E-08	4.14E-06	3.71E-06	6.90E-07	4.73E-07	8.27E-06	3.99E-06	8.50E-09
Spinal Skel.	3.79E-06	3.79E-06	3.81E-06	3.79E-06	1.81E-08	4.21E-06	3.78E-06	7.00E-07	6.77E-07	8.30E-06	4.07E-06	1.11E-08
Thalami	4.66E-03	5.72E-03	7.99E-03	3.24E-03	7.25E-03	1.98E-02	1.22E-02	1.48E-03	1.85E-03	6.55E-03	1.28E-02	2.87E-03
Thyroid	2.35E-06	2.36E-06	2.36E-06	2.36E-06	7.61E-09	2.55E-06	2.35E-06	4.34E-07	2.45E-07	5.36E-06	2.53E-06	6.21E-09
Trunk	6.60E-08	6.60E-08	6.62E-08	6.61E-08	1.37E-10	7.38E-08	6.56E-08	1.24E-08	5.17E-09	2.03E-07	7.20E-08	1.58E-10
White Matter	3.21E-05	3.50E-05	4.47E-05	2.96E-05	1.52E-05	4.20E-04	8.33E-05	5.84E-06	3.77E-06	9.30E-05	9.90E-05	1.75E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.43E-06	1.65E-04	9.73E-06	5.18E-05	6.48E-06	9.15E-05	3.54E-05	1.19E-04	2.03E-05	1.15E-05	9.03E-06	1.92E-05
Caud. Nucl.	7.53E-06	1.82E-04	1.45E-05	6.87E-05	1.04E-05	1.21E-04	2.24E-05	1.35E-04	5.70E-06	5.66E-06	7.06E-06	1.38E-05
Cerebellum	1.45E-06	9.94E-06	2.17E-06	1.06E-05	8.65E-07	2.17E-05	4.10E-06	2.22E-05	7.94E-07	1.01E-06	1.29E-06	2.63E-06
Cereb. Cort.	1.64E-06	1.16E-05	2.58E-06	1.23E-05	1.19E-06	2.51E-05	4.70E-06	2.58E-05	9.59E-07	1.15E-06	1.47E-06	2.99E-06
Cranium	1.71E-06	8.17E-06	2.95E-06	9.05E-06	2.05E-06	1.75E-05	3.49E-06	1.80E-05	1.63E-06	1.97E-06	2.32E-06	2.43E-06
Eyes	8.26E-07	6.27E-06	1.04E-06	6.51E-06	1.16E-07	1.39E-05	2.54E-06	1.42E-05	2.61E-07	4.45E-07	6.02E-07	1.59E-06
Lent. Nucl.	1.36E-05	7.24E-04	2.74E-05	1.78E-04	2.08E-05	2.53E-04	5.30E-05	3.48E-04	1.34E-05	1.14E-05	1.36E-05	2.70E-05
Mandible	1.00E-06	4.87E-06	1.27E-06	5.15E-06	3.73E-07	1.07E-05	2.10E-06	1.09E-05	5.49E-07	8.88E-07	1.08E-06	1.45E-06
Other Tissues	7.03E-07	5.05E-06	9.58E-07	5.37E-06	2.45E-07	1.12E-05	2.06E-06	1.15E-05	3.03E-07	4.41E-07	5.76E-07	1.30E-06
Skin	4.71E-07	3.77E-06	6.19E-07	3.98E-06	1.02E-07	8.39E-06	1.50E-06	8.66E-06	1.67E-07	2.63E-07	3.53E-07	9.22E-07
Spinal Col.	5.36E-07	3.42E-06	6.80E-07	3.54E-06	1.31E-07	7.39E-06	1.42E-06	7.50E-06	2.05E-07	3.18E-07	4.19E-07	9.17E-07
Spinal Skel.	8.21E-07	3.50E-06	1.04E-06	3.65E-06	3.39E-07	7.56E-06	1.55E-06	7.66E-06	4.77E-07	7.63E-07	9.23E-07	1.12E-06
Thalami	2.29E-04	9.89E-03	4.23E-04	2.37E-03	3.12E-04	4.07E-03	2.35E-03	6.02E-03	1.61E-03	8.21E-04	5.63E-04	1.23E-03
Thyroid	2.64E-07	2.16E-06	3.30E-07	2.20E-06	2.64E-08	4.63E-06	8.52E-07	4.69E-06	8.24E-08	1.52E-07	2.02E-07	5.23E-07
Trunk	5.48E-09	6.13E-08	7.02E-09	7.63E-08	2.07E-10	1.47E-07	2.26E-08	1.63E-07	1.27E-09	2.32E-09	3.35E-09	1.24E-08
White Matter	3.69E-06	7.36E-05	6.61E-06	3.33E-05	4.13E-06	5.96E-05	1.15E-05	6.74E-05	2.73E-06	2.76E-06	3.45E-06	6.85E-06

Table B.40: S values for the 5-year-old Phantom for Sources Located in the Third Ventricle.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.81E-05	9.20E-05	1.24E-04	6.02E-05	9.28E-05	5.10E-04	1.98E-04	2.14E-05	2.40E-05	1.45E-04	2.16E-04	3.39E-05
Caud. Nucl.	5.02E-05	5.03E-05	5.04E-05	5.03E-05	2.04E-07	8.50E-05	5.06E-05	9.28E-06	5.77E-06	1.13E-04	5.52E-05	1.46E-07
Cerebellum	1.11E-05	1.11E-05	1.12E-05	1.12E-05	3.92E-08	1.24E-05	1.11E-05	2.06E-06	1.36E-06	2.55E-05	1.20E-05	3.04E-08
Cereb. Cort.	1.26E-05	1.26E-05	1.27E-05	1.26E-05	4.36E-08	1.44E-05	1.26E-05	2.33E-06	1.50E-06	2.86E-05	1.36E-05	3.42E-08
Cranium	8.40E-06	8.41E-06	8.44E-06	8.41E-06	4.74E-08	9.44E-06	8.39E-06	1.55E-06	1.40E-06	1.92E-05	9.05E-06	2.67E-08
Eyes	6.68E-06	6.69E-06	6.70E-06	6.69E-06	1.38E-08	7.38E-06	6.64E-06	1.24E-06	7.63E-07	1.56E-05	7.19E-06	1.72E-08
Lent. Nucl.	7.05E-05	7.06E-05	7.08E-05	7.07E-05	2.85E-07	6.97E-04	8.27E-05	1.31E-05	8.12E-06	1.72E-04	1.03E-04	2.01E-07
Mandible	4.72E-06	4.73E-06	4.75E-06	4.73E-06	2.00E-08	5.27E-06	4.71E-06	8.74E-07	7.59E-07	1.08E-05	5.08E-06	1.34E-08
Other Tissues	4.99E-06	5.00E-06	5.01E-06	5.00E-06	1.45E-08	5.50E-06	4.96E-06	9.24E-07	5.80E-07	1.15E-05	5.36E-06	1.29E-08
Skin	4.15E-06	4.16E-06	4.17E-06	4.16E-06	1.06E-08	4.58E-06	4.13E-06	7.69E-07	4.37E-07	9.43E-06	4.46E-06	1.03E-08
Spinal Col.	3.91E-06	3.92E-06	3.93E-06	3.92E-06	9.38E-09	4.30E-06	3.90E-06	7.21E-07	4.70E-07	8.82E-06	4.20E-06	9.29E-09
Spinal Skel.	3.55E-06	3.55E-06	3.56E-06	3.55E-06	1.70E-08	3.95E-06	3.54E-06	6.56E-07	6.34E-07	7.92E-06	3.81E-06	1.08E-08
Thalami	2.28E-04	2.45E-04	3.88E-04	2.20E-04	1.51E-04	1.21E-02	1.57E-03	4.11E-05	2.40E-05	1.26E-03	2.04E-03	1.74E-06
Thyroid	2.26E-06	2.26E-06	2.27E-06	2.27E-06	4.44E-09	2.52E-06	2.24E-06	4.20E-07	2.21E-07	5.13E-06	2.44E-06	5.08E-09
Trunk	6.28E-08	6.29E-08	6.30E-08	6.30E-08	1.20E-10	7.04E-08	6.25E-08	1.18E-08	4.81E-09	1.96E-07	6.86E-08	1.52E-10
White Matter	5.15E-05	6.50E-05	1.05E-04	3.91E-05	6.80E-05	5.73E-04	2.10E-04	9.20E-06	6.23E-06	1.56E-04	2.34E-04	8.73E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.55E-06	1.66E-04	9.93E-06	5.27E-05	6.59E-06	9.32E-05	3.58E-05	1.21E-04	2.04E-05	1.15E-05	9.14E-06	1.94E-05
Caud. Nucl.	6.42E-06	4.74E-05	1.18E-05	5.03E-05	7.66E-06	1.02E-04	1.89E-05	1.04E-04	4.68E-06	4.65E-06	5.89E-06	1.18E-05
Cerebellum	1.51E-06	1.03E-05	2.26E-06	1.10E-05	9.22E-07	2.25E-05	4.23E-06	2.31E-05	8.37E-07	1.06E-06	1.35E-06	2.71E-06
Cereb. Cort.	1.65E-06	1.17E-05	2.58E-06	1.24E-05	1.16E-06	2.55E-05	4.75E-06	2.61E-05	9.61E-07	1.16E-06	1.48E-06	3.02E-06
Cranium	1.67E-06	7.92E-06	2.77E-06	8.70E-06	1.82E-06	1.70E-05	3.39E-06	1.74E-05	1.52E-06	1.90E-06	2.24E-06	2.37E-06
Eyes	8.32E-07	6.13E-06	1.06E-06	6.57E-06	1.36E-07	1.38E-05	2.50E-06	1.44E-05	2.81E-07	4.74E-07	6.33E-07	1.57E-06
Lent. Nucl.	9.11E-06	7.95E-05	1.74E-05	7.16E-05	1.20E-05	1.42E-04	2.66E-05	1.46E-04	6.84E-06	6.53E-06	8.27E-06	1.67E-05
Mandible	9.07E-07	4.36E-06	1.12E-06	4.62E-06	3.00E-07	9.57E-06	1.88E-06	9.80E-06	4.75E-07	7.84E-07	9.59E-07	1.31E-06
Other Tissues	6.36E-07	4.59E-06	8.56E-07	4.87E-06	2.02E-07	1.01E-05	1.87E-06	1.05E-05	2.66E-07	3.98E-07	5.20E-07	1.18E-06
Skin	4.70E-07	3.80E-06	6.20E-07	3.99E-06	1.01E-07	8.41E-06	1.52E-06	8.65E-06	1.65E-07	2.61E-07	3.51E-07	9.32E-07
Spinal Col.	5.13E-07	3.59E-06	6.71E-07	3.66E-06	1.27E-07	7.80E-06	1.48E-06	7.91E-06	1.97E-07	3.11E-07	4.10E-07	9.49E-07
Spinal Skel.	7.66E-07	3.28E-06	9.60E-07	3.46E-06	3.02E-07	7 13E-06	1.46E-06	7.26E-06	4.42E-07	7.18E-07	8.68E-07	1.05E-06
Thalami	2.79E-05	1.40E-03	5.84E-05	2.98E-04	4.72E-05	4.50E-04	8.20E-05	5.48E-04	2.19E-05	2.19E-05	2.67E-05	5.09E-05
Thyroid	2.44E-07	2.07E-06	3.06E-07	2.21E-06	3.07E-08	4.79E-06	8.06E-07	5.03E-06	7.75E-08	1.34E-07	1.80E-07	4.76E-07
Trunk	5.01E-09	5.84E-08	6.53E-09	7.33E-08	1.82E-10	1.41E-07	2.15E-08	1.56E-07	1.11E-09	2.05E-09	2.99E-09	1.17E-08
White Matter	4.21E-06	1.77E-04	7.65E-06	5.24E-05	4.91E-06	7.76E-05	1.66E-05	1.06E-04	3.92E-06	3.49E-06	4.20E-06	8.33E-06

Table B.41: S values for the 5-year-old Phantom for Sources Located in the Thyroid.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{125m}I	^{126}I	^{130}I	^{131}I	^{132}I	^{132m}I	^{133}I
Brain (Total)	1.58E-07	1.35E-06	1.99E-07	1.49E-06	1.58E-08	6.07E-07	1.19E-08	3.06E-06	5.31E-07	3.21E-06	4.50E-07	8.70E-07
Caud. Nucl.	1.71E-07	1.50E-06	2.20E-07	1.64E-06	2.13E-08	6.72E-07	1.60E-08	3.38E-06	5.89E-07	3.53E-06	4.98E-07	9.60E-07
Cerebellum	1.65E-07	1.50E-06	2.05E-07	1.64E-06	7.52E-09	6.64E-07	6.37E-09	3.37E-06	5.79E-07	3.54E-06	4.92E-07	9.60E-07
Cereb. Cort.	1.43E-07	1.27E-06	1.83E-07	1.39E-06	1.56E-08	5.68E-07	1.16E-08	2.87E-06	4.94E-07	3.02E-06	4.22E-07	8.15E-07
Cranium	2.42E-07	1.31E-06	2.98E-07	1.45E-06	7.02E-08	6.06E-07	5.04E-08	2.94E-06	5.47E-07	3.08E-06	4.52E-07	8.33E-07
Eyes	1.20E-07	1.26E-06	1.54E-07	1.40E-06	1.16E-09	5.71E-07	1.32E-09	2.95E-06	4.80E-07	3.14E-06	4.30E-07	8.17E-07
Lent. Nucl.	2.62E-07	2.20E-06	3.28E-07	2.31E-06	2.91E-08	9.62E-07	2.22E-08	4.79E-06	8.61E-07	4.91E-06	7.04E-07	1.39E-06
Mandible	7.01E-07	3.44E-06	9.53E-07	3.67E-06	3.80E-07	1.62E-06	2.61E-07	7.48E-06	1.48E-06	7.65E-06	1.20E-06	2.15E-06
Other Tissues	1.92E-06	7.15E-05	3.50E-06	2.22E-05	2.24E-06	8.86E-06	1.22E-06	3.51E-05	7.04E-06	4.44E-05	6.61E-06	1.65E-05
Skin	3.93E-07	3.22E-06	6.33E-07	3.44E-06	2.82E-07	1.49E-06	1.65E-07	7.08E-06	1.28E-06	7.31E-06	1.10E-06	2.02E-06
Spinal Col.	2.32E-06	1.71E-05	3.23E-06	1.82E-05	8.71E-07	7.85E-06	5.86E-07	3.81E-05	6.97E-06	3.94E-05	5.78E-06	1.09E-05
Spinal Skel.	3.32E-06	1.79E-05	5.77E-06	1.95E-05	3.93E-06	8.81E-06	2.47E-06	3.83E-05	7.42E-06	3.93E-05	6.54E-06	1.10E-05
Thalami	2.91E-07	2.30E-06	3.69E-07	2.45E-06	4.03E-08	1.01E-06	2.99E-08	5.00E-06	9.18E-07	5.14E-06	7.37E-07	1.45E-06
Thyroid	8.53E-04	3.17E-02	1.55E-03	8.01E-03	1.14E-03	6.78E-03	3.13E-03	1.47E-02	9.16E-03	2.14E-02	7.14E-03	1.78E-02
Trunk	1.93E-07	1.81E-06	2.89E-07	1.63E-06	1.10E-07	6.85E-07	6.72E-08	3.28E-06	5.92E-07	3.44E-06	5.07E-07	9.53E-07
White Matter	1.63E-07	1.35E-06	2.05E-07	1.49E-06	1.67E-08	6.09E-07	1.26E-08	3.07E-06	5.35E-07	3.22E-06	4.51E-07	8.71E-07

Table B.42: S values for the 5-year-old Phantom for Sources Located in the White Matter.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.40E-05	8.79E-05	1.20E-04	5.61E-05	9.28E-05	4.96E-04	1.94E-04	2.06E-05	2.35E-05	1.36E-04	2.12E-04	3.38E-05
Caud. Nucl.	3.88E-05	4.34E-05	5.88E-05	3.46E-05	2.47E-05	5.74E-04	1.18E-04	7.03E-06	4.44E-06	1.16E-04	1.40E-04	3.02E-06
Cerebellum	9.30E-06	9.31E-06	9.33E-06	9.31E-06	3.03E-08	2.06E-05	9.45E-06	1.72E-06	1.07E-06	2.14E-05	1.04E-05	2.45E-08
Cereb. Cort.	1.81E-05	1.96E-05	2.50E-05	1.67E-05	8.40E-06	2.23E-04	4.67E-05	3.29E-06	2.06E-06	5.24E-05	5.53E-05	9.60E-07
Cranium	9.73E-06	9.75E-06	9.79E-06	9.74E-06	5.94E-08	3.95E-05	1.03E-05	1.80E-06	1.48E-06	2.30E-05	1.18E-05	3.18E-08
Eyes	8.38E-06	8.40E-06	8.42E-06	8.40E-06	2.63E-08	1.15E-05	8.37E-06	1.55E-06	9.18E-07	1.93E-05	9.10E-06	2.10E-08
Lent. Nucl.	3.24E-05	3.57E-05	4.66E-05	2.95E-05	1.75E-05	4.29E-04	8.95E-05	5.90E-06	3.83E-06	9.50E-05	1.06E-04	2.15E-06
Mandible	3.43E-06	3.43E-06	3.44E-06	3.44E-06	1.33E-08	4.00E-06	3.42E-06	6.35E-07	5.09E-07	8.04E-06	3.69E-06	9.54E-09
Other Tissues	3.41E-06	3.41E-06	3.42E-06	3.41E-06	9.83E-09	4.08E-06	3.39E-06	6.31E-07	3.77E-07	7.92E-06	3.67E-06	8.70E-09
Skin	5.14E-06	5.14E-06	5.15E-06	5.15E-06	1.22E-08	7.60E-06	5.14E-06	9.49E-07	5.19E-07	1.15E-05	5.57E-06	1.27E-08
Spinal Col.	2.48E-06	2.48E-06	2.49E-06	2.48E-06	6.80E-09	2.80E-06	2.46E-06	4.58E-07	2.90E-07	5.73E-06	2.66E-06	5.77E-09
Spinal Skel.	2.36E-06	2.36E-06	2.37E-06	2.36E-06	1.10E-08	2.67E-06	2.35E-06	4.36E-07	3.77E-07	5.36E-06	2.54E-06	6.94E-09
Thalami	3.24E-05	3.53E-05	4.50E-05	2.98E-05	1.54E-05	4.16E-04	8.38E-05	5.87E-06	3.74E-06	9.24E-05	9.93E-05	1.80E-06
Thyroid	1.49E-06	1.49E-06	1.49E-06	1.49E-06	2.19E-09	1.69E-06	1.48E-06	2.75E-07	1.42E-07	3.60E-06	1.59E-06	3.35E-09
Trunk	3.81E-08	3.81E-08	3.82E-08	3.82E-08	8.57E-11	4.31E-08	3.79E-08	7.15E-09	2.86E-09	1.21E-07	4.17E-08	9.23E-11
White Matter	1.45E-04	1.74E-04	2.41E-04	1.06E-04	2.00E-04	8.61E-04	3.83E-04	4.25E-05	5.05E-05	2.43E-04	4.12E-04	7.54E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.95E-06	1.62E-04	8.93E-06	4.86E-05	6.02E-06	8.50E-05	3.42E-05	1.13E-04	2.00E-05	1.11E-05	8.57E-06	1.84E-05
Caud. Nucl.	4.07E-06	1.03E-04	7.46E-06	3.99E-05	4.88E-06	6.88E-05	1.35E-05	8.03E-05	3.21E-06	3.13E-06	3.87E-06	7.69E-06
Cerebellum	1.17E-06	8.81E-06	1.85E-06	9.19E-06	8.49E-07	1.88E-05	3.48E-06	1.93E-05	6.78E-07	8.10E-07	1.04E-06	2.19E-06
Cereb. Cort.	2.01E-06	4.12E-05	3.49E-06	1.87E-05	2.04E-06	3.37E-05	6.43E-06	3.81E-05	1.40E-06	1.46E-06	1.83E-06	3.80E-06
Cranium	1.76E-06	9.90E-06	3.50E-06	1.05E-05	2.87E-06	1.98E-05	3.87E-06	2.03E-05	1.92E-06	2.05E-06	2.41E-06	2.61E-06
Eyes	1.01E-06	7.75E-06	1.38E-06	8.16E-06	3.43E-07	1.72E-05	3.09E-06	1.77E-05	4.13E-07	5.85E-07	7.77E-07	1.90E-06
Lent. Nucl.	3.65E-06	7.86E-05	6.53E-06	3.35E-05	4.12E-06	5.89E-05	1.15E-05	6.75E-05	2.75E-06	2.72E-06	3.39E-06	6.75E-06
Mandible	6.04E-07	3.17E-06	7.57E-07	3.39E-06	2.00E-07	6.94E-06	1.34E-06	7.14E-06	3.06E-07	4.97E-07	6.13E-07	9.03E-07
Other Tissues	4.11E-07	3.14E-06	5.56E-07	3.35E-06	1.26E-07	6.95E-06	1.26E-06	7.19E-06	1.64E-07	2.44E-07	3.23E-07	7.83E-07
Skin	5.56E-07	4.75E-06	8.00E-07	4.90E-06	2.27E-07	1.02E-05	1.85E-06	1.04E-05	2.39E-07	3.24E-07	4.31E-07	1.13E-06
Spinal Col.	3.07E-07	2.27E-06	4.06E-07	2.38E-06	6.52E-08	5.00E-06	9.41E-07	5.12E-06	1.02E-07	1.60E-07	2.19E-07	6.02E-07
Spinal Skel.	4.53E-07	2.18E-06	5.66E-07	2.30E-06	1.64E-07	4.75E-06	9.34E-07	4.86E-06	2.48E-07	4.05E-07	4.93E-07	6.45E-07
Thalami	3.65E-06	7.39E-05	6.54E-06	3.31E-05	4.08E-06	5.95E-05	1.15E-05	6.71E-05	2.70E-06	2.73E-06	3.41E-06	6.83E-06
Thyroid	1.58E-07	1.36E-06	1.94E-07	1.45E-06	1.32E-08	3.01E-06	5.23E-07	3.11E-06	4.45E-08	7.75E-08	1.07E-07	3.07E-07
Trunk	2.96E-09	3.55E-08	3.87E-09	4.52E-08	7.91E-11	8.71E-08	1.30E-08	9.72E-08	6.26E-10	1.16E-09	1.72E-09	7.06E-09
White Matter	8.65E-06	3.16E-04	1.58E-05	8.67E-05	1.11E-05	1.50E-04	6.92E-05	2.07E-04	4.34E-05	2.32E-05	1.71E-05	3.68E-05

S Values in a Mathematical Model of the Head and Brain of a Ten-Year-Old

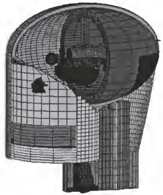


Table B.43: S values for the 10-year-old Phantom for Sources Located in the Brain (total).

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.78E-05	8.07E-05	1.10E-04	5.12E-05	8.59E-05	4.27E-04	1.75E-04	1.91E-05	2.20E-05	1.21E-04	1.90E-04	3.18E-05
Caud. Nucl.	7.36E-05	8.71E-05	1.18E-04	5.65E-05	8.85E-05	4.72E-04	1.88E-04	2.01E-05	2.25E-05	1.37E-04	2.05E-04	3.21E-05
Cerebellum	6.63E-05	7.90E-05	1.08E-04	4.98E-05	8.55E-05	4.11E-04	1.72E-04	1.88E-05	2.18E-05	1.17E-04	1.86E-04	3.18E-05
Cereb. Cort.	6.51E-05	7.76E-05	1.06E-04	4.88E-05	8.43E-05	3.82E-04	1.67E-04	1.86E-05	2.16E-05	1.13E-04	1.80E-04	3.15E-05
Cranium	1.09E-05	1.14E-05	1.38E-05	1.05E-05	3.07E-06	1.23E-04	2.59E-05	1.96E-06	1.55E-06	3.23E-05	3.09E-05	1.10E-07
Eyes	5.88E-06	5.89E-06	5.90E-06	5.89E-06	1.78E-08	8.07E-06	5.88E-06	1.09E-06	6.29E-07	1.36E-05	6.38E-06	1.48E-08
Lent. Nucl.	7.28E-05	8.60E-05	1.17E-04	5.58E-05	8.81E-05	4.79E-04	1.86E-04	2.01E-05	2.27E-05	1.33E-04	2.03E-04	3.23E-05
Mandible	3.04E-06	3.05E-06	3.06E-06	3.05E-06	1.15E-08	4.34E-06	3.05E-06	5.64E-07	4.34E-07	7.15E-06	3.32E-06	8.34E-09
Other Tissues	3.10E-06	3.11E-06	3.11E-06	3.11E-06	9.03E-09	6.59E-06	3.16E-06	5.75E-07	3.43E-07	7.37E-06	3.49E-06	7.98E-09
Skin	4.73E-06	4.73E-06	4.74E-06	4.74E-06	1.36E-08	2.38E-05	5.15E-06	8.74E-07	4.83E-07	1.11E-05	5.99E-06	1.19E-08
Spinal Col.	2.56E-06	2.56E-06	2.57E-06	2.57E-06	6.26E-09	4.64E-06	2.58E-06	4.75E-07	2.59E-07	6.35E-06	2.83E-06	6.46E-09
Spinal Skel.	2.48E-06	2.49E-06	2.49E-06	2.49E-06	1.03E-08	4.37E-06	2.51E-06	4.59E-07	3.93E-07	5.70E-06	2.75E-06	6.89E-09
Thalami	7.35E-05	8.69E-05	1.18E-04	5.63E-05	8.84E-05	4.78E-04	1.87E-04	2.01E-05	2.26E-05	1.37E-04	2.04E-04	3.20E-05
Thyroid	1.16E-06	1.16E-06	1.17E-06	1.16E-06	2.11E-09	1.31E-06	1.16E-06	2.16E-07	1.10E-07	2.77E-06	1.24E-06	2.62E-09
Trunk	2.42E-08	2.42E-08	2.43E-08	2.42E-08	3.76E-11	2.75E-08	2.40E-08	4.55E-09	1.68E-09	7.99E-08	2.65E-08	5.73E-11
White Matter	7.07E-05	8.38E-05	1.15E-04	5.37E-05	8.79E-05	4.73E-04	1.84E-04	1.96E-05	2.23E-05	1.30E-04	2.01E-04	3.21E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.47E-06	1.46E-04	8.01E-06	4.37E-05	5.37E-06	7.68E-05	3.16E-05	1.02E-04	1.87E-05	1.03E-05	7.89E-06	1.70E-05
Caud. Nucl.	5.14E-06	1.57E-04	9.19E-06	4.95E-05	6.09E-06	8.71E-05	3.35E-05	1.14E-04	1.91E-05	1.08E-05	8.50E-06	1.81E-05
Cerebellum	4.26E-06	1.43E-04	7.65E-06	4.19E-05	5.14E-06	7.34E-05	3.11E-05	9.82E-05	1.86E-05	1.02E-05	7.70E-06	1.66E-05
Cereb. Cort.	4.15E-06	1.39E-04	7.43E-06	4.10E-05	4.97E-06	7.20E-05	3.06E-05	9.65E-05	1.84E-05	1.01E-05	7.58E-06	1.64E-05
Cranium	1.85E-06	2.33E-05	3.84E-06	1.24E-05	3.33E-06	2.15E-05	4.16E-06	2.35E-05	2.06E-06	2.14E-06	2.51E-06	2.77E-06
Eyes	6.76E-07	5.43E-06	9.05E-07	5.68E-06	1.66E-07	1.20E-05	2.16E-06	1.23E-05	2.39E-07	3.61E-07	4.90E-07	1.33E-06
Lent. Nucl.	5.07E-06	1.55E-04	9.11E-06	4.83E-05	6.08E-06	8.53E-05	3.35E-05	1.11E-04	1.93E-05	1.08E-05	8.49E-06	1.82E-05
Mandible	5.11E-07	2.83E-06	6.39E-07	3.01E-06	1.59E-07	6.20E-06	1.17E-06	6.40E-06	2.52E-07	4.14E-07	5.12E-07	7.82E-07
Other Tissues	3.73E-07	2.93E-06	5.04E-07	3.07E-06	1.12E-07	6.37E-06	1.15E-06	6.61E-06	1.46E-07	2.18E-07	2.89E-07	7.14E-07
Skin	5.17E-07	4.82E-06	7.45E-07	4.58E-06	2.14E-07	9.57E-06	1.72E-06	9.84E-06	2.22E-07	3.01E-07	4.01E-07	1.04E-06
Spinal Col.	2.90E-07	2.39E-06	3.85E-07	2.59E-06	8.30E-08	5.15E-06	9.12E-07	5.35E-06	1.11E-07	1.60E-07	2.15E-07	5.46E-07
Spinal Skel.	4.71E-07	2.33E-06	5.94E-07	2.43E-06	1.76E-07	5.04E-06	9.84E-07	5.16E-06	2.55E-07	4.11E-07	5.02E-07	6.78E-07
Thalami	5.21E-06	1.56E-04	9.32E-06	4.96E-05	6.18E-06	8.73E-05	3.36E-05	1.14E-04	1.92E-05	1.09E-05	8.62E-06	1.82E-05
Thyroid	1.17E-07	1.06E-06	1.45E-07	1.13E-06	4.36E-09	2.28E-06	4.11E-07	2.33E-06	2.87E-08	5.45E-08	7.65E-08	2.45E-07
Trunk	1.73E-09	2.26E-08	2.29E-09	2.92E-08	2.85E-11	5.51E-08	8.13E-09	6.17E-08	3.42E-10	6.33E-10	9.57E-10	4.29E-09
White Matter	4.78E-06	1.54E-04	8.60E-06	4.66E-05	5.76E-06	8.17E-05	3.26E-05	1.08E-04	1.90E-05	1.06E-05	8.20E-06	1.76E-05

Table B.44: S values for the 10-year-old Phantom for Sources Located in the Caudate Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.31E-05	8.63E-05	1.17E-04	5.63E-05	8.76E-05	4.81E-04	1.87E-04	2.01E-05	2.26E-05	1.36E-04	2.04E-04	3.20E-05
Caud. Nucl.	6.39E-03	7.80E-03	1.07E-02	4.43E-03	9.89E-03	1.94E-02	1.55E-02	2.06E-03	2.62E-03	8.12E-03	1.60E-02	4.06E-03
Cerebellum	6.08E-06	6.09E-06	6.10E-06	6.09E-06	1.84E-08	6.70E-06	6.05E-06	1.13E-06	7.29E-07	1.39E-05	6.53E-06	1.55E-08
Cereb. Cort.	1.20E-05	1.20E-05	1.21E-05	1.21E-05	4.14E-08	1.49E-05	1.20E-05	2.23E-06	1.42E-06	2.74E-05	1.30E-05	3.22E-08
Cranium	8.06E-06	8.08E-06	8.11E-06	8.08E-06	4.55E-08	9.05E-06	8.06E-06	1.49E-06	1.32E-06	1.84E-05	8.69E-06	2.52E-08
Eyes	9.09E-06	9.10E-06	9.12E-06	9.11E-06	2.28E-08	9.96E-06	9.03E-06	1.68E-06	1.03E-06	2.08E-05	9.73E-06	2.28E-08
Lent. Nucl.	1.43E-04	1.81E-04	3.07E-04	1.09E-04	2.01E-04	3.56E-03	7.67E-04	2.54E-05	1.67E-05	5.45E-04	9.08E-04	2.34E-05
Mandible	3.82E-06	3.82E-06	3.83E-06	3.82E-06	1.53E-08	4.25E-06	3.80E-06	7.07E-07	5.94E-07	8.92E-06	4.11E-06	1.06E-08
Other Tissues	3.18E-06	3.18E-06	3.19E-06	3.18E-06	8.64E-09	3.50E-06	3.16E-06	5.88E-07	3.60E-07	7.39E-06	3.41E-06	8.07E-09
Skin	3.94E-06	3.94E-06	3.95E-06	3.95E-06	1.15E-08	4.32E-06	3.92E-06	7.29E-07	4.10E-07	8.95E-06	4.23E-06	1.00E-08
Spinal Col.	1.48E-06	1.49E-06	1.49E-06	1.49E-06	7.66E-09	1.60E-06	1.47E-06	2.74E-07	2.15E-07	3.23E-06	1.58E-06	3.96E-09
Spinal Skel.	1.63E-06	1.63E-06	1.64E-06	1.63E-06	7.77E-09	1.81E-06	1.62E-06	3.01E-07	3.04E-07	3.61E-06	1.75E-06	4.60E-09
Thalami	5.62E-05	5.89E-05	7.29E-05	5.47E-05	1.68E-05	1.29E-03	1.68E-04	1.02E-05	6.27E-06	1.88E-04	2.14E-04	5.42E-07
Thyroid	1.35E-06	1.36E-06	1.36E-06	1.36E-06	3.84E-09	1.46E-06	1.34E-06	2.50E-07	1.17E-07	3.21E-06	1.45E-06	3.07E-09
Trunk	2.53E-08	2.53E-08	2.53E-08	2.53E-08	4.91E-11	2.86E-08	2.51E-08	4.75E-09	1.82E-09	8.36E-08	2.77E-08	6.04E-11
White Matter	3.85E-05	4.33E-05	5.94E-05	3.43E-05	2.54E-05	5.88E-04	1.22E-04	6.96E-06	4.49E-06	1.19E-04	1.44E-04	2.91E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.13E-06	1.56E-04	9.21E-06	4.91E-05	6.13E-06	8.68E-05	3.35E-05	1.13E-04	1.92E-05	1.08E-05	8.53E-06	1.82E-05
Caud. Nucl.	3.07E-04	1.25E-02	5.61E-04	3.06E-03	4.11E-04	5.41E-03	3.28E-03	7.99E-03	2.28E-03	1.16E-03	7.86E-04	1.72E-03
Cerebellum	8.03E-07	5.60E-06	1.13E-06	5.92E-06	3.48E-07	1.23E-05	2.29E-06	1.26E-05	3.85E-07	5.39E-07	6.94E-07	1.46E-06
Cereb. Cort.	1.57E-06	1.12E-05	2.45E-06	1.19E-05	1.11E-06	2.43E-05	4.53E-06	2.49E-05	9.13E-07	1.10E-06	1.40E-06	2.87E-06
Cranium	1.57E-06	7.60E-06	2.63E-06	8.36E-06	1.73E-06	1.63E-05	3.24E-06	1.67E-05	1.43E-06	1.77E-06	2.08E-06	2.25E-06
Eyes	1.12E-06	8.32E-06	1.46E-06	8.79E-06	2.52E-07	1.83E-05	3.38E-06	1.88E-05	3.97E-07	6.16E-07	8.29E-07	2.13E-06
Lent. Nucl.	1.15E-05	6.57E-04	2.31E-05	1.56E-04	1.74E-05	2.18E-04	4.59E-05	3.05E-04	1.13E-05	9.74E-06	1.16E-05	2.29E-05
Mandible	7.07E-07	3.52E-06	8.65E-07	3.77E-06	2.04E-07	7.82E-06	1.51E-06	8.07E-06	3.45E-07	5.77E-07	7.13E-07	1.04E-06
Other Tissues	3.95E-07	2.91E-06	5.13E-07	3.11E-06	9.00E-08	6.48E-06	1.18E-06	6.70E-06	1.45E-07	2.30E-07	3.05E-07	7.39E-07
Skin	4.41E-07	3.61E-06	5.92E-07	3.79E-06	1.10E-07	8.02E-06	1.43E-06	8.27E-06	1.61E-07	2.44E-07	3.29E-07	8.75E-07
Spinal Col.	2.26E-07	1.35E-06	2.87E-07	1.40E-06	3.28E-08	2.95E-06	6.06E-07	2.98E-06	7.00E-08	1.20E-07	1.64E-07	4.20E-07
Spinal Skel.	3.69E-07	1.50E-06	4.22E-07	1.56E-06	7.33E-08	3.32E-06	6.83E-07	3.39E-06	1.67E-07	2.97E-07	3.68E-07	4.97E-07
Thalami	7.04E-06	1.52E-04	1.33E-05	6.16E-05	9.21E-06	1.10E-04	2.05E-05	1.21E-04	5.16E-06	5.25E-06	6.56E-06	1.28E-05
Thyroid	1.22E-07	1.24E-06	1.57E-07	1.29E-06	8.01E-09	2.77E-06	4.71E-07	2.86E-06	3.25E-08	6.07E-08	8.40E-08	2.72E-07
Trunk	1.89E-09	2.36E-08	2.47E-09	3.06E-08	3.44E-11	5.79E-08	8.55E-09	6.49E-08	3.86E-10	7.16E-10	1.07E-09	4.55E-09
White Matter	4.15E-06	1.06E-04	7.60E-06	4.03E-05	4.95E-06	6.88E-05	1.35E-05	8.10E-05	3.24E-06	3.16E-06	3.92E-06	7.80E-06

Table B.45: S values for the 10-year-old Phantom for Sources Located in the Cerebellum.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.61E-05	7.88E-05	1.08E-04	4.96E-05	8.54E-05	4.11E-04	1.72E-04	1.88E-05	2.17E-05	1.17E-04	1.86E-04	3.17E-05
Caud. Nucl.	6.31E-06	6.32E-06	6.33E-06	6.32E-06	2.23E-08	6.96E-06	6.27E-06	1.17E-06	7.21E-07	1.42E-05	6.76E-06	1.66E-08
Cerebellum	5.63E-04	6.86E-04	9.64E-04	4.01E-04	8.33E-04	3.39E-03	1.54E-03	1.70E-04	2.07E-04	9.10E-04	1.66E-03	3.16E-04
Cereb. Cort.	1.37E-05	1.47E-05	1.82E-05	1.28E-05	5.50E-06	1.51E-04	3.24E-05	2.50E-06	1.56E-06	3.86E-05	3.82E-05	6.33E-07
Cranium	1.17E-05	1.24E-05	1.55E-05	1.12E-05	3.90E-06	1.58E-04	3.13E-05	2.10E-06	1.65E-06	3.64E-05	3.76E-05	1.23E-07
Eyes	1.45E-06	1.45E-06	1.46E-06	1.45E-06	3.16E-09	1.62E-06	1.44E-06	2.70E-07	1.47E-07	3.75E-06	1.57E-06	3.34E-09
Lent. Nucl.	6.52E-06	6.52E-06	6.54E-06	6.53E-06	2.02E-08	7.20E-06	6.49E-06	1.21E-06	8.01E-07	1.53E-05	7.02E-06	1.67E-08
Mandible	1.87E-06	1.87E-06	1.88E-06	1.88E-06	6.28E-09	2.08E-06	1.86E-06	3.47E-07	2.67E-07	4.47E-06	2.02E-06	5.02E-09
Other Tissues	3.97E-06	3.97E-06	3.98E-06	3.97E-06	1.11E-08	1.14E-05	4.10E-06	7.35E-07	4.29E-07	9.41E-06	4.58E-06	1.01E-08
Skin	4.63E-06	4.64E-06	4.65E-06	4.64E-06	1.38E-08	1.97E-05	4.95E-06	8.57E-07	4.76E-07	1.08E-05	5.67E-06	1.18E-08
Spinal Col.	5.27E-06	5.28E-06	5.29E-06	5.28E-06	1.49E-08	8.73E-06	5.30E-06	9.75E-07	5.78E-07	1.24E-05	5.79E-06	1.37E-08
Spinal Skel.	5.10E-06	5.10E-06	5.12E-06	5.10E-06	2.10E-08	1.08E-05	5.19E-06	9.44E-07	7.57E-07	1.19E-05	5.72E-06	1.44E-08
Thalami	9.61E-06	9.63E-06	9.65E-06	9.63E-06	3.64E-08	1.06E-05	9.58E-06	1.78E-06	1.24E-06	2.26E-05	1.04E-05	2.57E-08
Thyroid	1.14E-06	1.15E-06	1.15E-06	1.15E-06	2.58E-09	1.27E-06	1.14E-06	2.13E-07	1.14E-07	3.03E-06	1.24E-06	2.76E-09
Trunk	2.97E-08	2.97E-08	2.98E-08	2.98E-08	5.14E-11	3.33E-08	2.96E-08	5.59E-09	2.05E-09	9.99E-08	3.27E-08	7.14E-11
White Matter	8.71E-06	8.72E-06	8.75E-06	8.73E-06	2.99E-08	1.54E-05	8.78E-06	1.61E-06	1.02E-06	2.00E-05	9.60E-06	2.34E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.24E-06	1.43E-04	7.63E-06	4.20E-05	5.14E-06	7.35E-05	3.10E-05	9.85E-05	1.85E-05	1.01E-05	7.68E-06	1.66E-05
Caud. Nucl.	7.94E-07	5.79E-06	1.11E-06	6.02E-06	3.32E-07	1.26E-05	2.34E-06	1.29E-05	3.80E-07	5.44E-07	6.98E-07	1.47E-06
Cerebellum	3.07E-05	1.27E-03	5.70E-05	3.20E-04	4.16E-05	5.43E-04	2.74E-04	7.78E-04	1.79E-04	9.34E-05	6.64E-05	1.44E-04
Cereb. Cort.	1.54E-06	2.86E-05	2.64E-06	1.41E-05	1.49E-06	2.58E-05	4.90E-06	2.88E-05	1.04E-06	1.10E-06	1.39E-06	2.91E-06
Cranium	1.96E-06	2.81E-05	4.26E-06	1.36E-05	3.84E-06	2.30E-05	4.45E-06	2.55E-05	2.29E-06	2.31E-06	2.70E-06	2.96E-06
Eyes	1.56E-07	1.33E-06	1.94E-07	1.52E-06	5.55E-09	3.11E-06	5.29E-07	3.33E-06	3.57E-08	6.53E-08	9.46E-08	3.19E-07
Lent. Nucl.	8.89E-07	6.02E-06	1.24E-06	6.53E-06	3.87E-07	1.35E-05	2.48E-06	1.40E-05	4.23E-07	5.80E-07	7.51E-07	1.59E-06
Mandible	3.18E-07	1.72E-06	3.63E-07	1.86E-06	4.13E-08	3.85E-06	7.22E-07	4.00E-06	1.24E-07	2.27E-07	2.87E-07	4.80E-07
Other Tissues	4.64E-07	3.81E-06	6.45E-07	3.91E-06	1.65E-07	8.09E-06	1.46E-06	8.37E-06	1.93E-07	2.74E-07	3.64E-07	9.01E-07
Skin	5.11E-07	4.62E-06	7.44E-07	4.49E-06	2.26E-07	9.38E-06	1.68E-06	9.65E-06	2.27E-07	3.02E-07	4.00E-07	1.03E-06
Spinal Col.	6.34E-07	4.90E-06	8.40E-07	5.15E-06	1.68E-07	1.08E-05	1.94E-06	1.12E-05	2.39E-07	3.63E-07	4.84E-07	1.20E-06
Spinal Skel.	8.91E-07	4.83E-06	1.19E-06	5.08E-06	4.21E-07	1.04E-05	1.99E-06	1.07E-05	5.32E-07	8.25E-07	1.00E-06	1.35E-06
Thalami	1.36E-06	8.92E-06	2.00E-06	9.73E-06	7.60E-07	2.01E-05	3.72E-06	2.09E-05	7.30E-07	9.62E-07	1.23E-06	2.42E-06
Thyroid	1.19E-07	1.05E-06	1.51E-07	1.22E-06	6.36E-09	2.48E-06	4.18E-07	2.66E-06	2.95E-08	5.49E-08	7.75E-08	2.51E-07
Trunk	2.11E-09	2.78E-08	2.80E-09	3.64E-08	2.41E-11	6.85E-08	1.00E-08	7.72E-08	3.92E-10	7.15E-10	1.11E-09	5.26E-09
White Matter	1.12E-06	8.18E-06	1.74E-06	8.62E-06	7.67E-07	1.76E-05	3.27E-06	1.81E-05	6.34E-07	7.71E-07	9.89E-07	2.07E-06

Table B.46: S values for the 10-year-old Phantom for Sources Located in the Cerebral Cortex.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.52E-05	7.78E-05	1.06E-04	4.89E-05	8.43E-05	3.82E-04	1.67E-04	1.86E-05	2.16E-05	1.13E-04	1.80E-04	3.16E-05
Caud. Nucl.	1.22E-05	1.22E-05	1.23E-05	1.23E-05	4.12E-08	1.55E-05	1.22E-05	2.26E-06	1.43E-06	2.74E-05	1.32E-05	3.37E-08
Cerebellum	1.37E-05	1.47E-05	1.82E-05	1.28E-05	5.49E-06	1.53E-04	3.22E-05	2.49E-06	1.57E-06	3.86E-05	3.80E-05	6.38E-07
Cereb. Cort.	1.27E-04	1.54E-04	2.14E-04	9.16E-05	1.83E-04	6.37E-04	3.31E-04	3.85E-05	4.67E-05	1.99E-04	3.52E-04	7.07E-05
Cranium	1.26E-05	1.36E-05	1.84E-05	1.19E-05	5.98E-06	2.20E-04	4.21E-05	2.23E-06	1.69E-06	4.32E-05	5.10E-05	1.88E-07
Eyes	6.08E-06	6.09E-06	6.10E-06	6.09E-06	1.75E-08	1.12E-05	6.13E-06	1.13E-06	6.50E-07	1.41E-05	6.72E-06	1.54E-08
Lent. Nucl.	1.21E-05	1.21E-05	1.22E-05	1.21E-05	7.16E-08	4.54E-05	1.32E-05	2.24E-06	1.44E-06	2.81E-05	1.50E-05	3.27E-08
Mandible	2.86E-06	2.86E-06	2.87E-06	2.86E-06	1.14E-08	5.32E-06	2.90E-06	5.29E-07	4.14E-07	6.83E-06	3.18E-06	8.00E-09
Other Tissues	2.97E-06	2.98E-06	2.98E-06	2.98E-06	8.54E-09	8.77E-06	3.08E-06	5.51E-07	3.22E-07	7.11E-06	3.46E-06	7.66E-09
Skin	5.18E-06	5.18E-06	5.20E-06	5.19E-06	1.56E-08	4.44E-05	6.10E-06	9.58E-07	5.32E-07	1.25E-05	7.48E-06	1.33E-08
Spinal Col.	2.17E-06	2.17E-06	2.17E-06	2.17E-06	5.25E-09	6.37E-06	2.24E-06	4.02E-07	2.69E-07	5.60E-06	2.52E-06	6.04E-09
Spinal Skel.	2.27E-06	2.27E-06	2.28E-06	2.27E-06	9.69E-09	5.04E-06	2.31E-06	4.20E-07	3.56E-07	5.28E-06	2.55E-06	6.29E-09
Thalami	1.28E-05	1.28E-05	1.28E-05	1.28E-05	4.26E-08	1.97E-05	1.28E-05	2.36E-06	1.47E-06	2.85E-05	1.39E-05	3.53E-08
Thyroid	1.12E-06	1.12E-06	1.12E-06	1.12E-06	2.93E-09	1.27E-06	1.11E-06	2.09E-07	1.01E-07	2.85E-06	1.23E-06	2.54E-09
Trunk	2.16E-08	2.16E-08	2.16E-08	2.16E-08	4.23E-11	2.42E-08	2.15E-08	4.06E-09	1.53E-09	7.26E-08	2.37E-08	5.35E-11
White Matter	1.73E-05	1.87E-05	2.34E-05	1.61E-05	7.35E-06	2.04E-04	4.26E-05	3.16E-06	1.99E-06	4.94E-05	5.03E-05	8.47E-07

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.16E-06	1.39E-04	7.45E-06	4.10E-05	4.98E-06	7.21E-05	3.07E-05	9.65E-05	1.84E-05	1.01E-05	7.59E-06	1.64E-05
Caud. Nucl.	1.59E-06	1.13E-05	2.48E-06	1.19E-05	1.14E-06	2.42E-05	4.57E-06	2.46E-05	9.40E-07	1.13E-06	1.44E-06	2.88E-06
Cerebellum	1.55E-06	2.85E-05	2.65E-06	1.41E-05	1.49E-06	2.57E-05	4.90E-06	2.87E-05	1.05E-06	1.11E-06	1.40E-06	2.92E-06
Cereb. Cort.	7.07E-06	2.71E-04	1.29E-05	7.17E-05	9.01E-06	1.25E-04	6.21E-05	1.76E-04	4.02E-05	2.11E-05	1.51E-05	3.28E-05
Cranium	2.02E-06	3.74E-05	4.51E-06	1.52E-05	4.18E-06	2.46E-05	4.68E-06	2.81E-05	2.39E-06	2.38E-06	2.78E-06	3.06E-06
Eyes	6.98E-07	5.67E-06	9.38E-07	5.92E-06	1.76E-07	1.23E-05	2.24E-06	1.27E-05	2.47E-07	3.66E-07	5.00E-07	1.38E-06
Lent. Nucl.	1.60E-06	1.23E-05	2.52E-06	1.19E-05	1.19E-06	2.45E-05	4.57E-06	2.51E-05	9.37E-07	1.13E-06	1.44E-06	2.90E-06
Mandible	4.90E-07	2.70E-06	6.19E-07	2.85E-06	1.67E-07	5.84E-06	1.11E-06	6.03E-06	2.49E-07	4.04E-07	4.99E-07	7.42E-07
Other Tissues	3.50E-07	2.87E-06	4.78E-07	2.94E-06	1.12E-07	6.10E-06	1.09E-06	6.33E-06	1.39E-07	2.03E-07	2.70E-07	6.75E-07
Skin	5.69E-07	5.76E-06	8.39E-07	5.02E-06	2.67E-07	1.05E-05	1.88E-06	1.08E-05	2.54E-07	3.28E-07	4.38E-07	1.15E-06
Spinal Col.	2.94E-07	2.09E-06	3.73E-07	2.22E-06	5.26E-08	4.57E-06	8.33E-07	4.80E-06	9.76E-08	1.63E-07	2.18E-07	5.37E-07
Spinal Skel.	4.24E-07	2.15E-06	5.46E-07	2.24E-06	1.74E-07	4.61E-06	9.00E-07	4.74E-06	2.35E-07	3.71E-07	4.53E-07	6.19E-07
Thalami	1.63E-06	1.19E-05	2.54E-06	1.24E-05	1.15E-06	2.56E-05	4.75E-06	2.61E-05	9.53E-07	1.16E-06	1.47E-06	2.98E-06
Thyroid	1.06E-07	1.04E-06	1.38E-07	1.18E-06	1.07E-08	2.53E-06	3.99E-07	2.75E-06	2.87E-08	4.94E-08	6.95E-08	2.29E-07
Trunk	1.55E-09	2.02E-08	2.07E-09	2.64E-08	2.92E-11	4.95E-08	7.32E-09	5.56E-08	3.00E-10	5.56E-10	8.48E-10	3.90E-09
White Matter	1.97E-06	3.76E-05	3.39E-06	1.78E-05	1.96E-06	3.25E-05	6.21E-06	3.64E-05	1.35E-06	1.42E-06	1.79E-06	3.70E-06

Table B.47: S values for the 10-year-old Phantom for Sources Located in the Cranial CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.29E-05	2.83E-05	4.20E-05	1.70E-05	2.77E-05	2.09E-04	7.49E-05	4.35E-06	2.99E-06	5.85E-05	8.31E-05	5.17E-06
Caud. Nucl.	9.20E-06	9.21E-06	9.23E-06	9.21E-06	2.49E-08	1.01E-05	9.15E-06	1.70E-06	1.03E-06	2.08E-05	9.85E-06	2.30E-08
Cerebellum	2.76E-05	3.49E-05	5.34E-05	1.96E-05	3.74E-05	2.72E-04	9.76E-05	5.25E-06	3.64E-06	7.14E-05	1.08E-04	6.95E-06
Cereb. Cort.	3.52E-05	4.58E-05	7.27E-05	2.36E-05	5.43E-05	3.64E-04	1.37E-04	6.73E-06	4.75E-06	9.17E-05	1.51E-04	1.01E-05
Cranium	5.66E-05	7.72E-05	1.30E-04	3.41E-05	1.06E-04	5.10E-04	2.49E-04	1.09E-05	8.30E-06	1.47E-04	2.72E-04	1.94E-05
Eyes	6.30E-06	6.30E-06	6.32E-06	6.31E-06	2.22E-08	2.20E-05	6.55E-06	1.17E-06	6.43E-07	1.53E-05	7.42E-06	1.71E-08
Lent. Nucl.	9.45E-06	9.46E-06	9.49E-06	9.46E-06	3.56E-08	1.73E-05	9.54E-06	1.75E-06	1.10E-06	2.15E-05	1.04E-05	2.57E-08
Mandible	3.08E-06	3.08E-06	3.10E-06	3.08E-06	1.79E-08	9.96E-06	3.36E-06	5.70E-07	4.33E-07	7.49E-06	3.80E-06	8.16E-09
Other Tissues	3.47E-06	3.48E-06	3.49E-06	3.48E-06	1.85E-08	2.48E-05	4.31E-06	6.43E-07	3.69E-07	8.79E-06	5.19E-06	8.98E-09
Skin	6.21E-06	6.22E-06	6.28E-06	6.23E-06	5.29E-08	1.08E-04	1.35E-05	1.15E-06	6.26E-07	1.86E-05	1.77E-05	1.59E-08
Spinal Col.	3.54E-06	3.54E-06	3.55E-06	3.55E-06	9.21E-09	2.01E-05	4.04E-06	6.53E-07	3.22E-07	8.06E-06	4.73E-06	8.49E-09
Spinal Skel.	2.90E-06	2.90E-06	2.91E-06	2.90E-06	1.48E-08	1.53E-05	3.29E-06	5.36E-07	4.20E-07	6.93E-06	3.85E-06	8.29E-09
Thalami	8.75E-06	8.76E-06	8.78E-06	8.76E-06	3.40E-08	9.88E-06	8.72E-06	1.62E-06	1.09E-06	2.03E-05	9.42E-06	2.41E-08
Thyroid	1.16E-06	1.16E-06	1.17E-06	1.16E-06	4.02E-09	1.25E-06	1.15E-06	2.16E-07	1.05E-07	2.95E-06	1.24E-06	3.01E-09
Trunk	2.20E-08	2.21E-08	2.21E-08	2.21E-08	4.20E-11	2.50E-08	2.19E-08	4.14E-09	1.60E-09	7.26E-08	2.41E-08	5.33E-11
White Matter	1.03E-05	1.03E-05	1.03E-05	1.03E-05	3.63E-08	5.13E-05	1.10E-05	1.90E-06	1.17E-06	2.44E-05	1.28E-05	2.75E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.58E-06	6.31E-05	2.74E-06	2.04E-05	1.54E-06	3.24E-05	7.53E-06	4.31E-05	1.62E-06	1.26E-06	1.52E-06	3.40E-06
Caud. Nucl.	1.12E-06	8.47E-06	1.71E-06	8.99E-06	6.81E-07	1.83E-05	3.42E-06	1.87E-05	5.97E-07	7.38E-07	9.56E-07	2.15E-06
Cerebellum	1.73E-06	8.20E-05	3.06E-06	2.43E-05	1.81E-06	3.69E-05	8.91E-06	5.13E-05	1.95E-06	1.43E-06	1.70E-06	3.81E-06
Cereb. Cort.	1.88E-06	1.14E-04	3.41E-06	3.04E-05	2.08E-06	4.37E-05	1.11E-05	6.42E-05	2.47E-06	1.65E-06	1.92E-06	4.39E-06
Cranium	2.97E-06	2.07E-04	7.22E-06	4.92E-05	6.98E-06	6.16E-05	1.76E-05	1.01E-04	6.01E-06	4.06E-06	4.48E-06	6.28E-06
Eyes	6.97E-07	6.11E-06	9.40E-07	6.25E-06	1.87E-07	1.29E-05	2.28E-06	1.34E-05	2.52E-07	3.70E-07	5.03E-07	1.38E-06
Lent. Nucl.	1.23E-06	8.87E-06	1.85E-06	9.31E-06	7.70E-07	1.91E-05	3.53E-06	1.97E-05	6.65E-07	8.29E-07	1.07E-06	2.22E-06
Mandible	5.10E-07	3.12E-06	6.59E-07	3.08E-06	1.93E-07	6.28E-06	1.19E-06	6.51E-06	2.64E-07	4.13E-07	5.11E-07	7.85E-07
Other Tissues	4.00E-07	4.02E-06	5.59E-07	3.45E-06	1.45E-07	7.12E-06	1.27E-06	7.40E-06	1.64E-07	2.32E-07	3.08E-07	7.82E-07
Skin	6.67E-07	1.25E-05	1.00E-06	6.14E-06	3.37E-07	1.24E-05	2.25E-06	1.29E-05	3.00E-07	3.76E-07	5.04E-07	1.37E-06
Spinal Col.	3.52E-07	3.75E-06	4.79E-07	3.28E-06	9.80E-08	6.89E-06	1.23E-06	6.96E-06	1.31E-07	1.93E-07	2.59E-07	7.19E-07
Spinal Skel.	4.94E-07	3.08E-06	6.65E-07	2.86E-06	2.40E-07	5.87E-06	1.12E-06	6.03E-06	2.90E-07	4.41E-07	5.38E-07	7.52E-07
Thalami	1.20E-06	8.10E-06	1.78E-06	8.69E-06	6.95E-07	1.78E-05	3.35E-06	1.84E-05	6.31E-07	7.98E-07	1.03E-06	2.16E-06
Thyroid	1.15E-07	1.06E-06	1.44E-07	1.18E-06	1.04E-08	2.37E-06	4.04E-07	2.49E-06	3.27E-08	5.74E-08	7.89E-08	2.34E-07
Trunk	1.66E-09	2.06E-08	2.17E-09	2.65E-08	3.66E-11	4.96E-08	7.47E-09	5.53E-08	3.33E-10	6.10E-10	9.20E-10	4.01E-09
White Matter	1.29E-06	1.04E-05	2.07E-06	1.02E-05	9.98E-07	2.09E-05	3.84E-06	2.15E-05	7.45E-07	8.65E-07	1.11E-06	2.41E-06

Table B.48: S values for the 10-year-old Phantom for Sources Located in the Cranium.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	3.10E-06	5.13E-10	2.06E-06	2.49E-08	7.93E-06	1.27E-06	4.98E-07	3.94E-06	8.83E-07	6.11E-07	5.34E-06	6.77E-08
Caud. Nucl.	3.24E-08	2.46E-10	2.45E-08	2.00E-09	5.77E-08	1.06E-06	3.07E-07	3.05E-06	6.46E-07	1.93E-07	4.99E-07	5.51E-08
Cerebellum	3.98E-06	5.64E-10	2.64E-06	2.56E-08	1.02E-05	1.36E-06	5.69E-07	4.20E-06	9.63E-07	7.22E-07	6.74E-06	7.23E-08
Cereb. Cort.	6.11E-06	7.36E-10	4.06E-06	4.79E-08	1.56E-05	1.40E-06	6.03E-07	4.45E-06	1.05E-06	1.01E-06	1.00E-05	7.54E-08
Cranium	2.78E-04	3.62E-05	2.39E-04	8.98E-05	3.40E-04	1.05E-05	7.16E-06	9.58E-05	1.28E-04	1.53E-04	3.03E-04	2.18E-03
Eyes	2.18E-08	4.96E-11	1.58E-08	1.48E-09	1.16E-07	7.06E-07	1.06E-07	2.42E-06	3.42E-07	1.20E-07	3.83E-07	3.89E-08
Lent. Nucl.	2.87E-08	2.14E-10	2.23E-08	2.77E-09	5.84E-08	1.09E-06	3.26E-07	3.23E-06	6.80E-07	2.02E-07	5.25E-07	5.78E-08
Mandible	4.13E-07	2.28E-09	2.99E-07	2.37E-08	8.62E-07	5.18E-07	1.49E-07	1.24E-06	4.16E-07	1.94E-07	7.69E-07	2.46E-08
Other Tissues	2.11E-06	1.39E-08	1.55E-06	1.40E-07	4.10E-06	4.21E-07	1.11E-07	1.48E-06	4.41E-07	5.79E-07	2.98E-06	2.35E-08
Skin	2.82E-05	2.45E-07	2.19E-05	2.64E-06	4.45E-05	8.25E-07	2.86E-07	5.17E-06	4.27E-06	8.64E-06	3.40E-05	5.98E-08
Spinal Col.	1.36E-06	8.63E-09	9.98E-07	8.16E-08	2.69E-06	3.69E-07	6.81E-08	1.19E-06	3.21E-07	3.80E-07	1.97E-06	1.93E-08
Spinal Skel.	1.00E-06	6.19E-09	7.35E-07	6.62E-08	2.01E-06	5.17E-07	1.94E-07	1.24E-06	5.20E-07	3.48E-07	1.54E-06	2.45E-08
Thalami	3.82E-08	2.69E-10	2.95E-08	2.31E-09	6.20E-08	1.09E-06	3.07E-07	3.15E-06	6.63E-07	2.00E-07	5.23E-07	5.67E-08
Thyroid	1.83E-09	2.39E-10	1.63E-09	8.58E-10	4.55E-09	1.15E-07	5.70E-09	3.84E-07	4.60E-08	1.85E-08	6.11E-08	6.33E-09
Trunk	5.01E-11	2.75E-13	3.71E-11	3.45E-12	1.08E-10	1.59E-09	2.32E-11	7.23E-09	5.24E-10	2.41E-10	1.16E-09	8.96E-11
White Matter	3.59E-08	2.99E-10	2.76E-08	2.82E-09	8.17E-08	1.13E-06	3.94E-07	3.44E-06	7.21E-07	2.09E-07	5.58E-07	6.00E-08

Table B.49: S values for the 10-year-old Phantom for Sources Located in the Lateral Ventricles.

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.48E-05	8.79E-05	1.19E-04	5.79E-05	8.76E-05	4.83E-04	1.88E-04	2.04E-05	2.28E-05	1.39E-04	2.05E-04	3.20E-05
Caud. Nucl.	6.08E-05	6.13E-05	6.71E-05	6.08E-05	5.69E-06	1.55E-03	1.49E-04	1.13E-05	6.84E-06	1.95E-04	1.99E-04	1.95E-07
Cerebellum	1.01E-05	1.01E-05	1.01E-05	1.01E-05	3.48E-08	1.11E-05	1.00E-05	1.86E-06	1.22E-06	2.29E-05	1.08E-05	2.68E-08
Cereb. Cort.	1.46E-05	1.46E-05	1.47E-05	1.46E-05	1.58E-07	6.97E-05	1.68E-05	2.69E-06	1.72E-06	3.48E-05	1.95E-05	3.96E-08
Cranium	7.68E-06	7.69E-06	7.72E-06	7.69E-06	4.16E-08	8.60E-06	7.67E-06	1.42E-06	1.26E-06	1.75E-05	8.27E-06	2.39E-08
Eyes	5.37E-06	5.38E-06	5.39E-06	5.38E-06	1.43E-08	5.86E-06	5.33E-06	9.93E-07	5.75E-07	1.21E-05	5.72E-06	1.36E-08
Lent. Nucl.	4.01E-05	4.04E-05	4.30E-05	4.00E-05	2.74E-06	4.26E-04	6.66E-05	7.40E-06	4.70E-06	1.08E-04	8.18E-05	1.31E-07
Mandible	2.91E-06	2.91E-06	2.92E-06	2.91E-06	1.14E-08	3.23E-06	2.90E-06	5.39E-07	4.48E-07	6.80E-06	3.13E-06	8.18E-09
Other Tissues	2.83E-06	2.83E-06	2.84E-06	2.83E-06	7.81E-09	3.12E-06	2.81E-06	5.23E-07	3.18E-07	6.59E-06	3.04E-06	7.17E-09
Skin	3.84E-06	3.84E-06	3.85E-06	3.85E-06	1.06E-08	4.23E-06	3.82E-06	7.11E-07	4.02E-07	8.74E-06	4.12E-06	9.82E-09
Spinal Col.	2.29E-06	2.29E-06	2.29E-06	2.29E-06	5.23E-09	2.49E-06	2.27E-06	4.22E-07	2.63E-07	5.18E-06	2.44E-06	5.55E-09
Spinal Skel.	2.11E-06	2.11E-06	2.12E-06	2.11E-06	9.30E-09	2.35E-06	2.10E-06	3.90E-07	3.50E-07	4.71E-06	2.26E-06	6.23E-09
Thalami	5.69E-05	5.83E-05	6.53E-05	5.60E-05	8.69E-06	8.24E-04	1.14E-04	1.04E-05	6.50E-06	1.61E-04	1.42E-04	4.87E-07
Thyroid	1.06E-06	1.06E-06	1.06E-06	1.06E-06	2.53E-09	1.24E-06	1.05E-06	1.98E-07	1.09E-07	2.87E-06	1.15E-06	2.90E-09
Trunk	2.55E-08	2.55E-08	2.56E-08	2.55E-08	4.60E-11	2.88E-08	2.54E-08	4.81E-09	1.77E-09	8.85E-08	2.81E-08	6.04E-11
White Matter	3.80E-05	4.26E-05	5.82E-05	3.39E-05	2.47E-05	5.21E-04	1.17E-04	6.87E-06	4.46E-06	1.15E-04	1.37E-04	2.86E-06

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.36E-06	1.57E-04	9.60E-06	5.08E-05	6.34E-06	9.02E-05	3.42E-05	1.16E-04	1.93E-05	1.10E-05	8.75E-06	1.86E-05
Caud. Nucl.	7.72E-06	1.38E-04	1.48E-05	6.48E-05	1.05E-05	1.22E-04	2.27E-05	1.29E-04	5.75E-06	5.70E-06	7.16E-06	1.42E-05
Cerebellum	1.34E-06	9.29E-06	2.02E-06	9.91E-06	8.14E-07	2.03E-05	3.82E-06	2.08E-05	7.37E-07	9.37E-07	1.20E-06	2.45E-06
Cereb. Cort.	1.90E-06	1.57E-05	3.08E-06	1.45E-05	1.54E-06	2.94E-05	5.48E-06	3.02E-05	1.16E-06	1.34E-06	1.71E-06	3.47E-06
Cranium	1.51E-06	7.21E-06	2.39E-06	7.87E-06	1.45E-06	1.55E-05	3.08E-06	1.59E-05	1.30E-06	1.69E-06	2.00E-06	2.14E-06
Eyes	6.17E-07	4.90E-06	7.90E-07	5.11E-06	9.25E-08	1.06E-05	1.97E-06	1.08E-05	1.99E-07	3.39E-07	4.57E-07	1.22E-06
Lent. Nucl.	5.27E-06	6.16E-05	9.55E-06	4.18E-05	6.13E-06	8.15E-05	1.51E-05	8.54E-05	3.77E-06	3.88E-06	4.89E-06	9.53E-06
Mandible	5.35E-07	2.68E-06	6.31E-07	2.85E-06	1.17E-07	5.91E-06	1.15E-06	6.08E-06	2.42E-07	4.24E-07	5.26E-07	7.83E-07
Other Tissues	3.49E-07	2.59E-06	4.48E-07	2.76E-06	6.90E-08	5.77E-06	1.05E-06	5.97E-06	1.24E-07	2.03E-07	2.69E-07	6.54E-07
Skin	4.30E-07	3.52E-06	5.76E-07	3.71E-06	1.05E-07	7.79E-06	1.40E-06	8.03E-06	1.57E-07	2.44E-07	3.26E-07	8.59E-07
Spinal Col.	2.89E-07	2.09E-06	3.60E-07	2.16E-06	4.13E-08	4.60E-06	8.50E-07	4.70E-06	9.57E-08	1.65E-07	2.20E-07	5.36E-07
Spinal Skel.	4.21E-07	1.94E-06	4.96E-07	2.01E-06	1.01E-07	4.22E-06	8.48E-07	4.29E-06	2.00E-07	3.50E-07	4.30E-07	5.95E-07
Thalami	7.26E-06	1.05E-04	1.36E-05	5.98E-05	9.30E-06	1.14E-04	2.11E-05	1.21E-04	5.39E-06	5.35E-06	6.73E-06	1.32E-05
Thyroid	1.18E-07	9.79E-07	1.46E-07	1.15E-06	7.62E-09	2.27E-06	3.88E-07	2.44E-06	3.00E-08	5.36E-08	7.57E-08	2.35E-07
Trunk	1.83E-09	2.39E-08	2.42E-09	3.19E-08	3.09E-11	5.95E-08	8.60E-09	6.75E-08	3.66E-10	6.82E-10	1.03E-09	4.53E-09
White Matter	4.12E-06	1.02E-04	7.44E-06	3.96E-05	4.74E-06	6.80E-05	1.33E-05	7.97E-05	3.18E-06	3.15E-06	3.90E-06	7.73E-06

Table B.50: S values for the 10-year-old Phantom for Sources Located in the Lentiform Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.22E-05	8.53E-05	1.16E-04	5.53E-05	8.76E-05	4.79E-04	1.86E-04	1.99E-05	2.25E-05	1.34E-04	2.03E-04	3.20E-05
Caud. Nucl.	1.43E-04	1.81E-04	3.07E-04	1.09E-04	2.02E-04	3.56E-03	7.69E-04	2.53E-05	1.66E-05	5.45E-04	9.09E-04	2.35E-05
Cerebellum	6.68E-06	6.68E-06	6.70E-06	6.69E-06	2.02E-08	7.35E-06	6.64E-06	1.23E-06	7.96E-07	1.51E-05	7.16E-06	1.75E-08
Cereb. Cort.	1.22E-05	1.22E-05	1.22E-05	1.22E-05	6.91E-08	4.61E-05	1.32E-05	2.25E-06	1.43E-06	2.85E-05	1.50E-05	3.25E-08
Cranium	8.49E-06	8.50E-06	8.54E-06	8.50E-06	4.92E-08	1.18E-05	8.53E-06	1.57E-06	1.40E-06	1.95E-05	9.26E-06	2.66E-08
Eyes	8.38E-06	8.39E-06	8.41E-06	8.40E-06	2.45E-08	9.27E-06	8.33E-06	1.55E-06	9.58E-07	1.92E-05	8.98E-06	2.18E-08
Lent. Nucl.	3.59E-03	4.39E-03	6.11E-03	2.50E-03	5.55E-03	1.49E-02	9.21E-03	1.14E-03	1.44E-03	4.96E-03	9.67E-03	2.22E-03
Mandible	5.52E-06	5.53E-06	5.55E-06	5.53E-06	2.43E-08	6.16E-06	5.51E-06	1.02E-06	8.62E-07	1.26E-05	5.94E-06	1.57E-08
Other Tissues	4.54E-06	4.55E-06	4.56E-06	4.55E-06	1.34E-08	5.04E-06	4.52E-06	8.41E-07	5.22E-07	1.04E-05	4.88E-06	1.17E-08
Skin	3.82E-06	3.82E-06	3.83E-06	3.83E-06	1.04E-08	4.21E-06	3.79E-06	7.06E-07	3.98E-07	8.66E-06	4.09E-06	9.81E-09
Spinal Col.	2.08E-06	2.08E-06	2.08E-06	2.08E-06	4.51E-09	2.38E-06	2.06E-06	3.84E-07	2.83E-07	4.76E-06	2.22E-06	6.02E-09
Spinal Skel.	2.30E-06	2.31E-06	2.32E-06	2.31E-06	1.10E-08	2.58E-06	2.30E-06	4.26E-07	4.25E-07	5.10E-06	2.48E-06	6.74E-09
Thalami	1.52E-04	1.89E-04	3.11E-04	1.18E-04	1.96E-04	3.73E-03	7.64E-04	2.70E-05	1.78E-05	5.63E-04	9.08E-04	2.31E-05
Thyroid	1.60E-06	1.60E-06	1.61E-06	1.61E-06	2.81E-09	1.78E-06	1.59E-06	2.99E-07	1.88E-07	4.21E-06	1.74E-06	3.64E-09
Trunk	3.38E-08	3.39E-08	3.39E-08	3.39E-08	6.97E-11	3.80E-08	3.37E-08	6.36E-09	2.56E-09	1.09E-07	3.71E-08	8.09E-11
White Matter	3.20E-05	3.53E-05	4.62E-05	2.91E-05	1.73E-05	4.28E-04	8.88E-05	5.81E-06	3.78E-06	9.44E-05	1.05E-04	2.03E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.03E-06	1.55E-04	9.01E-06	4.82E-05	5.98E-06	8.50E-05	3.32E-05	1.11E-04	1.91E-05	1.07E-05	8.43E-06	1.80E-05
Caud. Nucl.	1.15E-05	6.58E-04	2.30E-05	1.56E-04	1.74E-05	2.16E-04	4.55E-05	3.04E-04	1.14E-05	9.82E-06	1.17E-05	2.26E-05
Cerebellum	8.77E-07	6.14E-06	1.23E-06	6.45E-06	3.75E-07	1.35E-05	2.51E-06	1.39E-05	4.21E-07	5.94E-07	7.64E-07	1.60E-06
Cereb. Cort.	1.59E-06	1.24E-05	2.52E-06	1.21E-05	1.19E-06	2.46E-05	4.57E-06	2.53E-05	9.31E-07	1.11E-06	1.41E-06	2.90E-06
Cranium	1.67E-06	8.08E-06	2.90E-06	8.90E-06	2.03E-06	1.72E-05	3.43E-06	1.77E-05	1.58E-06	1.88E-06	2.22E-06	2.38E-06
Eyes	1.04E-06	7.67E-06	1.32E-06	8.08E-06	1.66E-07	1.69E-05	3.12E-06	1.74E-05	3.44E-07	5.77E-07	7.75E-07	1.97E-06
Lent. Nucl.	1.77E-04	7.49E-03	3.26E-04	1.80E-03	2.40E-04	3.12E-03	1.82E-03	4.61E-03	1.25E-03	6.39E-04	4.37E-04	9.52E-04
Mandible	1.03E-06	5.10E-06	1.32E-06	5.42E-06	4.07E-07	1.12E-05	2.18E-06	1.15E-05	5.65E-07	8.91E-07	1.09E-06	1.50E-06
Other Tissues	5.71E-07	4.17E-06	7.67E-07	4.42E-06	1.75E-07	9.21E-06	1.69E-06	9.49E-06	2.32E-07	3.47E-07	4.56E-07	1.07E-06
Skin	4.24E-07	3.49E-06	5.65E-07	3.66E-06	9.25E-08	7.70E-06	1.39E-06	7.91E-06	1.46E-07	2.29E-07	3.10E-07	8.56E-07
Spinal Col.	3.13E-07	1.90E-06	3.86E-07	2.00E-06	4.87E-08	4.14E-06	8.16E-07	4.22E-06	1.02E-07	1.70E-07	2.29E-07	5.45E-07
Spinal Skel.	5.18E-07	2.13E-06	6.08E-07	2.21E-06	1.37E-07	4.66E-06	9.56E-07	4.74E-06	2.58E-07	4.45E-07	5.44E-07	6.92E-07
Thalami	1.29E-05	6.57E-04	2.58E-05	1.64E-04	1.95E-05	2.37E-04	4.94E-05	3.23E-04	1.25E-05	1.07E-05	1.28E-05	2.53E-05
Thyroid	2.00E-07	1.48E-06	2.52E-07	1.71E-06	2.05E-08	3.51E-06	6.14E-07	3.77E-06	5.65E-08	9.95E-08	1.38E-07	3.90E-07
Trunk	2.68E-09	3.16E-08	3.47E-09	4.02E-08	6.71E-11	7.67E-08	1.16E-08	8.54E-08	5.67E-10	1.04E-09	1.54E-09	6.26E-09
White Matter	3.61E-06	7.80E-05	6.47E-06	3.32E-05	4.06E-06	5.85E-05	1.14E-05	6.71E-05	2.70E-06	2.71E-06	3.38E-06	6.72E-06

Table B.51: S values for the 10-year-old Phantom for Sources Located in the Spinal CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	3.15E-06	3.15E-06	3.16E-06	3.16E-06	9.00E-09	5.55E-06	3.18E-06	5.83E-07	3.50E-07	7.44E-06	3.48E-06	7.93E-09
Caud. Nucl.	2.64E-06	2.64E-06	2.65E-06	2.64E-06	8.67E-09	2.94E-06	2.62E-06	4.87E-07	2.93E-07	5.93E-06	2.82E-06	6.27E-09
Cerebellum	5.48E-06	5.48E-06	5.50E-06	5.49E-06	1.61E-08	9.96E-06	5.53E-06	1.01E-06	6.16E-07	1.29E-05	6.06E-06	1.38E-08
Cereb. Cort.	2.91E-06	2.91E-06	2.92E-06	2.91E-06	8.22E-09	6.99E-06	2.97E-06	5.39E-07	3.22E-07	6.95E-06	3.30E-06	7.39E-09
Cranium	3.98E-06	4.22E-06	5.04E-06	3.77E-06	1.28E-06	2.84E-05	8.16E-06	7.28E-07	5.82E-07	1.08E-05	9.39E-06	1.52E-07
Eyes	1.38E-06	1.38E-06	1.38E-06	1.38E-06	2.35E-09	1.52E-06	1.37E-06	2.55E-07	1.23E-07	3.39E-06	1.50E-06	3.36E-09
Lent. Nucl.	3.40E-06	3.41E-06	3.42E-06	3.41E-06	1.08E-08	3.78E-06	3.39E-06	6.31E-07	4.14E-07	8.10E-06	3.67E-06	8.41E-09
Mandible	3.68E-06	3.68E-06	3.69E-06	3.68E-06	1.46E-08	4.10E-06	3.66E-06	6.81E-07	5.51E-07	8.55E-06	3.96E-06	1.02E-08
Other Tissues	1.06E-05	1.06E-05	1.06E-05	1.06E-05	3.20E-08	1.47E-05	1.06E-05	1.96E-06	1.17E-06	2.45E-05	1.15E-05	2.71E-08
Skin	3.87E-06	3.87E-06	3.88E-06	3.87E-06	1.07E-08	4.26E-06	3.84E-06	7.15E-07	3.83E-07	8.74E-06	4.15E-06	9.84E-09
Spinal Col.	6.14E-04	9.00E-04	1.84E-03	3.58E-04	1.51E-03	1.10E-02	4.69E-03	1.06E-04	7.27E-05	2.58E-03	5.27E-03	1.72E-04
Spinal Skel.	1.08E-04	1.31E-04	2.08E-04	8.74E-05	1.22E-04	2.38E-03	4.92E-04	1.92E-05	1.44E-05	3.84E-04	5.83E-04	1.37E-05
Thalami	4.89E-06	4.90E-06	4.91E-06	4.90E-06	1.46E-08	5.42E-06	4.87E-06	9.07E-07	5.85E-07	1.15E-05	5.26E-06	1.23E-08
Thyroid	1.30E-05	1.30E-05	1.30E-05	1.30E-05	4.45E-08	1.44E-05	1.29E-05	2.40E-06	1.47E-06	2.95E-05	1.39E-05	3.35E-08
Trunk	4.59E-07	4.64E-07	4.79E-07	4.56E-07	2.37E-08	1.14E-06	5.37E-07	8.52E-08	4.79E-08	1.18E-06	5.97E-07	3.62E-09
White Matter	2.81E-06	2.82E-06	2.82E-06	2.82E-06	7.94E-09	3.14E-06	2.80E-06	5.21E-07	3.10E-07	6.57E-06	3.02E-06	6.98E-09

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	3.81E-07	2.94E-06	4.92E-07	3.09E-06	7.36E-08	6.43E-06	1.17E-06	6.65E-06	1.30E-07	2.09E-07	2.82E-07	7.26E-07
Caud. Nucl.	3.18E-07	2.41E-06	3.93E-07	2.48E-06	3.06E-08	5.17E-06	9.71E-07	5.24E-06	9.64E-08	1.76E-07	2.36E-07	6.10E-07
Cerebellum	6.68E-07	5.12E-06	8.82E-07	5.38E-06	1.62E-07	1.12E-05	2.04E-06	1.15E-05	2.42E-07	3.74E-07	5.01E-07	1.28E-06
Cereb. Cort.	3.50E-07	2.76E-06	4.56E-07	2.87E-06	7.34E-08	5.97E-06	1.08E-06	6.20E-06	1.20E-07	1.90E-07	2.56E-07	6.70E-07
Cranium	6.47E-07	7.23E-06	9.38E-07	4.09E-06	4.44E-07	7.63E-06	1.50E-06	8.37E-06	4.32E-07	5.92E-07	7.16E-07	9.75E-07
Eyes	1.26E-07	1.27E-06	1.62E-07	1.38E-06	1.07E-09	2.97E-06	4.92E-07	3.15E-06	2.39E-08	4.52E-08	6.89E-08	2.86E-07
Lent. Nucl.	4.62E-07	3.13E-06	5.64E-07	3.38E-06	5.79E-08	7.08E-06	1.29E-06	7.38E-06	1.48E-07	2.57E-07	3.44E-07	8.22E-07
Mandible	6.59E-07	3.38E-06	7.57E-07	3.58E-06	1.06E-07	7.49E-06	1.43E-06	7.72E-06	2.79E-07	5.10E-07	6.35E-07	9.69E-07
Other Tissues	1.27E-06	9.77E-06	1.70E-06	1.03E-05	3.57E-07	2.15E-05	3.91E-06	2.21E-05	4.95E-07	7.48E-07	9.92E-07	2.44E-06
Skin	4.08E-07	3.54E-06	5.43E-07	3.71E-06	8.34E-08	7.84E-06	1.39E-06	8.08E-06	1.37E-07	2.16E-07	2.94E-07	8.39E-07
Spinal Col.	2.74E-05	3.90E-03	5.70E-05	6.90E-04	4.49E-05	7.03E-04	1.70E-04	1.33E-03	3.99E-05	2.99E-05	3.27E-05	6.39E-05
Spinal Skel.	1.27E-05	4.25E-04	2.97E-05	1.22E-04	2.84E-05	1.75E-04	3.69E-05	2.29E-04	1.71E-05	1.55E-05	1.79E-05	2.07E-05
Thalami	6.51E-07	4.49E-06	8.12E-07	4.81E-06	1.09E-07	1.00E-05	1.84E-06	1.04E-05	2.23E-07	3.73E-07	4.97E-07	1.17E-06
Thyroid	1.60E-06	1.19E-05	2.17E-06	1.25E-05	5.12E-07	2.61E-05	4.80E-06	2.68E-05	6.76E-07	1.01E-06	1.31E-06	3.01E-06
Trunk	5.14E-08	4.92E-07	6.84E-08	4.71E-07	1.28E-08	9.51E-07	1.67E-07	1.01E-06	1.85E-08	2.83E-08	3.81E-08	1.01E-07
White Matter	3.39E-07	2.58E-06	4.29E-07	2.74E-06	5.37E-08	5.71E-06	1.04E-06	5.89E-06	1.11E-07	1.86E-07	2.50E-07	6.43E-07

Table B.52: S values for the 10-year-old Phantom for Sources Located in the Spinal Skeleton.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	1.03E-08	5.96E-11	7.83E-09	7.71E-10	2.28E-08	3.71E-07	3.55E-08	1.14E-06	1.75E-07	6.33E-08	1.83E-07	1.97E-08
Caud. Nucl.	1.28E-08	9.78E-11	9.67E-09	8.63E-10	2.53E-08	3.20E-07	1.74E-08	9.46E-07	1.40E-07	5.42E-08	1.58E-07	1.72E-08
Cerebellum	1.84E-08	1.05E-10	1.38E-08	1.23E-09	4.57E-08	6.52E-07	7.88E-08	2.03E-06	3.22E-07	1.13E-07	3.25E-07	3.49E-08
Cereb. Cort.	9.33E-09	5.35E-11	7.06E-09	6.95E-10	2.24E-08	3.36E-07	3.39E-08	1.06E-06	1.58E-07	5.72E-08	1.68E-07	1.80E-08
Cranium	1.02E-06	5.89E-09	7.38E-07	6.03E-08	2.09E-06	6.22E-07	2.12E-07	1.46E-06	5.87E-07	3.57E-07	1.63E-06	2.94E-08
Eyes	6.08E-09	1.78E-12	4.84E-09	3.63E-10	8.92E-09	1.35E-07	1.08E-09	4.91E-07	4.23E-08	2.07E-08	7.69E-08	7.68E-09
Lent. Nucl.	1.06E-08	2.25E-11	7.95E-09	5.93E-10	2.29E-08	4.54E-07	3.24E-08	1.32E-06	2.08E-07	7.59E-08	2.11E-07	4.20E-02
Mandible	1.72E-08	1.83E-10	1.31E-08	1.35E-09	3.13E-08	6.63E-07	8.48E-08	1.44E-06	4.29E-07	1.32E-07	2.70E-07	3.07E-08
Other Tissues	3.03E-06	1.80E-08	2.21E-06	1.90E-07	6.19E-06	1.38E-06	3.52E-07	4.47E-06	1.06E-06	9.41E-07	4.72E-06	7.49E-08
Skin	1.27E-08	9.62E-11	9.68E-09	1.05E-09	2.61E-08	4.20E-07	7.64E-08	1.44E-06	2.10E-07	7.19E-08	2.20E-07	2.31E-08
Spinal Col.	3.17E-06	2.02E-09	1.50E-06	2.24E-08	2.79E-05	8.42E-06	3.67E-06	2.62E-05	5.45E-06	1.52E-06	1.44E-05	4.56E-07
Spinal Skel.	7.77E-04	9.17E-05	6.59E-04	2.31E-04	1.01E-03	3.21E-05	2.40E-05	2.59E-04	3.35E-04	4.05E-04	8.71E-04	4.83E-06
Thalami	1.23E-08	6.61E-11	9.33E-09	8.65E-10	2.60E-08	6.06E-07	5.48E-08	1.78E-06	2.99E-07	1.05E-07	2.79E-07	3.18E-08
Thyroid	4.32E-08	8.72E-10	3.40E-08	6.14E-09	8.18E-08	1.60E-06	3.75E-07	5.01E-06	9.44E-07	2.95E-07	7.92E-07	8.53E-08
Trunk	1.88E-08	1.10E-10	1.38E-08	1.16E-09	3.86E-08	4.76E-08	5.93E-09	1.56E-07	2.46E-08	1.22E-08	4.83E-08	2.54E-09
White Matter	9.21E-09	5.40E-11	7.11E-09	7.40E-10	1.76E-08	3.34E-07	2.73E-08	1.01E-06	1.55E-07	5.67E-08	1.62E-07	1.75E-08

Table B.53: S values for the 10-year-old Phantom for Sources Located in the Thalami.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.35E-05	8.66E-05	1.17E-04	5.66E-05	8.76E-05	4.81E-04	1.87E-04	2.01E-05	2.27E-05	1.36E-04	2.04E-04	3.20E-05
Caud. Nucl.	5.54E-05	5.80E-05	7.17E-05	5.39E-05	1.64E-05	1.28E-03	1.67E-04	1.00E-05	6.36E-06	1.88E-04	2.12E-04	5.38E-07
Cerebellum	1.01E-05	1.01E-05	1.01E-05	1.01E-05	3.55E-08	1.11E-05	1.00E-05	1.86E-06	1.22E-06	2.28E-05	1.08E-05	2.73E-08
Cereb. Cort.	1.22E-05	1.22E-05	1.22E-05	1.22E-05	4.20E-08	1.91E-05	1.23E-05	2.26E-06	1.45E-06	2.78E-05	1.33E-05	3.30E-08
Cranium	8.22E-06	8.23E-06	8.26E-06	8.23E-06	4.77E-08	9.23E-06	8.21E-06	1.52E-06	1.37E-06	1.87E-05	8.86E-06	2.59E-08
Eyes	6.37E-06	6.38E-06	6.39E-06	6.39E-06	1.61E-08	6.91E-06	6.32E-06	1.18E-06	6.55E-07	1.41E-05	6.80E-06	1.56E-08
Lent. Nucl.	1.51E-04	1.88E-04	3.10E-04	1.18E-04	1.95E-04	3.73E-03	7.63E-04	2.69E-05	1.76E-05	5.62E-04	9.06E-04	2.28E-05
Mandible	4.81E-06	4.81E-06	4.83E-06	4.81E-06	2.03E-08	5.35E-06	4.79E-06	8.90E-07	7.67E-07	1.10E-05	5.17E-06	1.38E-08
Other Tissues	4.80E-06	4.81E-06	4.82E-06	4.81E-06	1.37E-08	5.30E-06	4.77E-06	8.89E-07	5.59E-07	1.10E-05	5.15E-06	1.24E-08
Skin	3.70E-06	3.71E-06	3.72E-06	3.71E-06	9.32E-09	4.09E-06	3.68E-06	6.85E-07	3.83E-07	8.48E-06	3.97E-06	9.25E-09
Spinal Col.	3.10E-06	3.10E-06	3.11E-06	3.10E-06	1.46E-08	3.39E-06	3.09E-06	5.74E-07	4.16E-07	7.19E-06	3.36E-06	7.98E-09
Spinal Skel.	3.20E-06	3.21E-06	3.22E-06	3.21E-06	1.55E-08	3.57E-06	3.20E-06	5.92E-07	5.84E-07	7.11E-06	3.44E-06	9.63E-09
Thalami	4.41E-03	5.41E-03	7.56E-03	3.06E-03	6.86E-03	1.89E-02	1.15E-02	1.39E-03	1.75E-03	6.23E-03	1.21E-02	2.71E-03
Thyroid	1.74E-06	1.74E-06	1.74E-06	1.74E-06	5.01E-09	1.95E-06	1.73E-06	3.24E-07	1.93E-07	4.55E-06	1.89E-06	4.28E-09
Trunk	3.91E-08	3.92E-08	3.93E-08	3.92E-08	7.66E-11	4.39E-08	3.90E-08	7.36E-09	3.04E-09	1.28E-07	4.29E-08	9.34E-11
White Matter	3.23E-05	3.52E-05	4.48E-05	2.98E-05	1.52E-05	4.20E-04	8.36E-05	5.86E-06	3.77E-06	9.32E-05	9.93E-05	1.76E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.20E-06	1.56E-04	9.29E-06	4.95E-05	6.15E-06	8.76E-05	3.37E-05	1.14E-04	1.92E-05	1.09E-05	8.59E-06	1.83E-05
Caud. Nucl.	7.14E-06	1.51E-04	1.35E-05	6.12E-05	9.25E-06	1.10E-04	2.05E-05	1.21E-04	5.16E-06	5.24E-06	6.57E-06	1.29E-05
Cerebellum	1.35E-06	9.27E-06	1.99E-06	9.83E-06	7.63E-07	2.03E-05	3.80E-06	2.07E-05	7.24E-07	9.36E-07	1.20E-06	2.43E-06
Cereb. Cort.	1.61E-06	1.14E-05	2.51E-06	1.21E-05	1.15E-06	2.47E-05	4.60E-06	2.53E-05	9.35E-07	1.13E-06	1.44E-06	2.93E-06
Cranium	1.64E-06	7.75E-06	2.72E-06	8.49E-06	1.79E-06	1.66E-05	3.32E-06	1.70E-05	1.48E-06	1.85E-06	2.18E-06	2.32E-06
Eyes	7.11E-07	5.81E-06	8.84E-07	6.02E-06	6.48E-08	1.27E-05	2.30E-06	1.30E-05	2.06E-07	3.69E-07	5.03E-07	1.40E-06
Lent. Nucl.	1.29E-05	6.55E-04	2.57E-05	1.64E-04	1.93E-05	2.36E-04	4.92E-05	3.22E-04	1.24E-05	1.07E-05	1.29E-05	2.52E-05
Mandible	9.18E-07	4.43E-06	1.14E-06	4.71E-06	3.11E-07	9.74E-06	1.91E-06	9.99E-06	4.87E-07	8.03E-07	9.81E-07	1.32E-06
Other Tissues	6.12E-07	4.41E-06	8.21E-07	4.68E-06	1.87E-07	9.76E-06	1.80E-06	1.01E-05	2.51E-07	3.76E-07	4.94E-07	1.14E-06
Skin	4.11E-07	3.39E-06	5.38E-07	3.58E-06	7.91E-08	7.50E-06	1.35E-06	7.73E-06	1.40E-07	2.26E-07	3.04E-07	8.21E-07
Spinal Col.	4.50E-07	2.86E-06	5.77E-07	3.07E-06	9.26E-08	6.60E-06	1.23E-06	6.91E-06	1.65E-07	2.73E-07	3.59E-07	8.15E-07
Spinal Skel.	7.11E-07	2.96E-06	8.72E-07	3.09E-06	2.53E-07	6.45E-06	1.32E-06	6.55E-06	3.90E-07	6.39E-07	7.76E-07	9.55E-07
Thalami	2.17E-04	9.38E-03	4.01E-04	2.25E-03	2.95E-04	3.85E-03	2.22E-03	5.71E-03	1.52E-03	7.76E-04	5.32E-04	1.16E-03
Thyroid	2.11E-07	1.61E-06	2.67E-07	1.88E-06	3.24E-08	3.78E-06	6.47E-07	4.08E-06	6.71E-08	1.11E-07	1.50E-07	3.99E-07
Trunk	3.17E-09	3.65E-08	4.10E-09	4.71E-08	8.35E-11	8.86E-08	1.35E-08	9.89E-08	6.67E-10	1.23E-09	1.82E-09	7.37E-09
White Matter	3.70E-06	7.38E-05	6.62E-06	3.33E-05	4.14E-06	5.98E-05	1.16E-05	6.75E-05	2.74E-06	2.78E-06	3.47E-06	6.87E-06

Table B.54: S values for the 10-year-old Phantom for Sources Located in the Third Ventricle.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.43E-05	8.74E-05	1.18E-04	5.74E-05	8.76E-05	4.82E-04	1.88E-04	2.03E-05	2.28E-05	1.38E-04	2.05E-04	3.20E-05
Caud. Nucl.	4.58E-05	4.58E-05	4.60E-05	4.58E-05	1.80E-07	6.26E-05	4.58E-05	8.47E-06	5.27E-06	1.04E-04	4.96E-05	1.31E-07
Cerebellum	1.04E-05	1.04E-05	1.05E-05	1.04E-05	3.76E-08	1.15E-05	1.04E-05	1.93E-06	1.27E-06	2.36E-05	1.12E-05	2.85E-08
Cereb. Cort.	1.22E-05	1.22E-05	1.23E-05	1.22E-05	4.22E-08	1.39E-05	1.22E-05	2.26E-06	1.47E-06	2.77E-05	1.31E-05	3.31E-08
Cranium	7.90E-06	7.91E-06	7.94E-06	7.91E-06	4.48E-08	8.87E-06	7.90E-06	1.46E-06	1.33E-06	1.80E-05	8.52E-06	2.48E-08
Eyes	5.74E-06	5.75E-06	5.76E-06	5.75E-06	1.38E-08	6.35E-06	5.70E-06	1.06E-06	6.53E-07	1.35E-05	6.16E-06	1.52E-08
Lent. Nucl.	6.63E-05	6.64E-05	6.66E-05	6.64E-05	2.66E-07	5.81E-04	7.61E-05	1.23E-05	7.59E-06	1.60E-04	9.34E-05	1.89E-07
Mandible	4.41E-06	4.41E-06	4.43E-06	4.42E-06	1.78E-08	4.89E-06	4.39E-06	8.16E-07	6.95E-07	1.01E-05	4.74E-06	1.26E-08
Other Tissues	4.37E-06	4.37E-06	4.38E-06	4.37E-06	1.32E-08	4.81E-06	4.34E-06	8.08E-07	5.02E-07	1.01E-05	4.68E-06	1.14E-08
Skin	3.67E-06	3.67E-06	3.68E-06	3.68E-06	9.61E-09	4.02E-06	3.65E-06	6.79E-07	3.90E-07	8.37E-06	3.93E-06	9.30E-09
Spinal Col.	3.20E-06	3.20E-06	3.21E-06	3.20E-06	7.64E-09	3.49E-06	3.18E-06	5.92E-07	4.13E-07	7.10E-06	3.41E-06	7.66E-09
Spinal Skel.	3.10E-06	3.11E-06	3.12E-06	3.11E-06	1.36E-08	3.43E-06	3.09E-06	5.74E-07	5.54E-07	6.86E-06	3.33E-06	9.10E-09
Thalami	2.15E-04	2.28E-04	3.44E-04	2.09E-04	1.21E-04	1.12E-02	1.38E-03	3.90E-05	2.27E-05	1.14E-03	1.80E-03	1.43E-06
Thyroid	1.72E-06	1.72E-06	1.73E-06	1.73E-06	6.30E-09	1.95E-06	1.71E-06	3.20E-07	1.71E-07	4.25E-06	1.85E-06	5.51E-09
Trunk	3.62E-08	3.63E-08	3.64E-08	3.63E-08	8.35E-11	4.11E-08	3.61E-08	6.82E-09	2.80E-09	1.22E-07	3.98E-08	8.76E-11
White Matter	5.23E-05	6.61E-05	1.07E-04	3.96E-05	6.98E-05	5.89E-04	2.16E-04	9.34E-06	6.33E-06	1.60E-04	2.42E-04	8.90E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.31E-06	1.57E-04	9.49E-06	5.03E-05	6.26E-06	8.91E-05	3.40E-05	1.15E-04	1.93E-05	1.10E-05	8.70E-06	1.85E-05
Caud. Nucl.	5.91E-06	4.29E-05	1.08E-05	4.60E-05	6.98E-06	9.17E-05	1.71E-05	9.38E-05	4.33E-06	4.32E-06	5.46E-06	1.07E-05
Cerebellum	1.40E-06	9.62E-06	2.08E-06	1.02E-05	8.11E-07	2.11E-05	3.95E-06	2.17E-05	7.60E-07	9.77E-07	1.25E-06	2.53E-06
Cereb. Cort.	1.62E-06	1.13E-05	2.50E-06	1.20E-05	1.10E-06	2.47E-05	4.61E-06	2.53E-05	9.29E-07	1.14E-06	1.45E-06	2.94E-06
Cranium	1.60E-06	7.43E-06	2.56E-06	8.13E-06	1.59E-06	1.60E-05	3.20E-06	1.63E-05	1.39E-06	1.79E-06	2.12E-06	2.24E-06
Eyes	7.14E-07	5.25E-06	8.92E-07	5.63E-06	9.13E-08	1.17E-05	2.14E-06	1.22E-05	2.17E-07	3.67E-07	5.01E-07	1.34E-06
Lent. Nucl.	8.49E-06	7.29E-05	1.62E-05	6.74E-05	1.11E-05	1.34E-04	2.50E-05	1.37E-04	6.39E-06	6.15E-06	7.78E-06	1.57E-05
Mandible	8.36E-07	4.06E-06	1.02E-06	4.29E-06	2.49E-07	8.96E-06	1.74E-06	9.19E-06	4.23E-07	7.09E-07	8.70E-07	1.20E-06
Other Tissues	5.52E-07	4.01E-06	7.30E-07	4.24E-06	1.54E-07	8.85E-06	1.63E-06	9.11E-06	2.20E-07	3.38E-07	4.43E-07	1.02E-06
Skin	4.17E-07	3.36E-06	5.45E-07	3.53E-06	7.74E-08	7.42E-06	1.35E-06	7.62E-06	1.39E-07	2.26E-07	3.06E-07	8.31E-07
Spinal Col.	4.59E-07	2.92E-06	5.85E-07	3.05E-06	1.02E-07	6.24E-06	1.23E-06	6.32E-06	1.65E-07	2.57E-07	3.44E-07	8.09E-07
Spinal Skel.	6.73E-07	2.86E-06	8.21E-07	2.99E-06	2.27E-07	6.21E-06	1.27E-06	6.30E-06	3.61E-07	5.95E-07	7.25E-07	9.14E-07
Thalami	2.64E-05	1.23E-03	5.51E-05	2.74E-04	4.43E-05	4.27E-04	7.78E-05	5.08E-04	2.07E-05	2.04E-05	2.50E-05	4.83E-05
Thyroid	1.88E-07	1.58E-06	2.33E-07	1.71E-06	2.01E-08	3.45E-06	6.13E-07	3.57E-06	5.80E-08	1.01E-07	1.37E-07	3.67E-07
Trunk	2.92E-09	3.39E-08	3.78E-09	4.43E-08	6.67E-11	8.27E-08	1.25E-08	9.29E-08	6.09E-10	1.12E-09	1.67E-09	6.80E-09
White Matter	4.26E-06	1.82E-04	7.75E-06	5.33E-05	4.97E-06	7.85E-05	1.69E-05	1.07E-04	3.97E-06	3.54E-06	4.25E-06	8.45E-06

Table B.55: S values for the 10-year-old Phantom for Sources Located in the Thyroid.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{125m}I	^{126}I	^{130}I	^{131}I	^{132}I	^{132m}I	^{133}I
Brain (Total)	1.26E-07	1.09E-06	1.57E-07	1.21E-06	9.99E-09	4.89E-07	7.73E-09	2.48E-06	4.26E-07	2.61E-06	3.63E-07	7.01E-07
Caud. Nucl.	1.57E-07	1.13E-06	1.89E-07	1.28E-06	8.35E-09	5.30E-07	6.89E-09	2.70E-06	4.65E-07	2.89E-06	4.00E-07	7.47E-07
Cerebellum	1.25E-07	1.11E-06	1.55E-07	1.24E-06	4.45E-09	4.99E-07	3.95E-09	2.54E-06	4.34E-07	2.69E-06	3.71E-07	7.18E-07
Cereb. Cort.	1.15E-07	1.02E-06	1.45E-07	1.13E-06	9.85E-09	4.56E-07	7.54E-09	2.31E-06	3.96E-07	2.44E-06	3.38E-07	6.55E-07
Cranium	1.91E-07	1.08E-06	2.29E-07	1.19E-06	4.20E-08	4.96E-07	3.10E-08	2.43E-06	4.46E-07	2.55E-06	3.70E-07	6.90E-07
Eyes	1.05E-07	1.04E-06	1.32E-07	1.20E-06	7.78E-10	4.75E-07	9.23E-10	2.46E-06	3.99E-07	2.66E-06	3.59E-07	6.83E-07
Lent. Nucl.	2.08E-07	1.63E-06	2.56E-07	1.82E-06	2.27E-08	7.44E-07	1.71E-08	3.77E-06	6.44E-07	4.00E-06	5.57E-07	1.06E-06
Mandible	6.33E-07	3.00E-06	8.56E-07	3.21E-06	3.40E-07	1.42E-06	2.33E-07	6.54E-06	1.30E-06	6.70E-06	1.06E-06	1.87E-06
Other Tissues	1.65E-06	5.18E-05	2.99E-06	1.78E-05	1.88E-06	7.21E-06	1.03E-06	2.95E-05	5.79E-06	3.59E-05	5.38E-06	1.26E-05
Skin	3.91E-07	3.42E-06	6.48E-07	3.41E-06	3.19E-07	1.48E-06	1.82E-07	6.99E-06	1.26E-06	7.20E-06	1.09E-06	2.00E-06
Spinal Col.	1.54E-06	1.15E-05	2.08E-06	1.21E-05	4.46E-07	5.23E-06	3.07E-07	2.56E-05	4.68E-06	2.65E-05	3.86E-06	7.28E-06
Spinal Skel.	2.26E-06	1.19E-05	3.63E-06	1.30E-05	2.16E-06	5.80E-06	1.41E-06	2.57E-05	5.01E-06	2.64E-05	4.29E-06	7.38E-06
Thalami	2.28E-07	1.79E-06	2.78E-07	1.95E-06	2.41E-08	7.87E-07	1.82E-08	3.94E-06	7.01E-07	4.09E-06	5.79E-07	1.13E-06
Thyroid	3.88E-04	1.56E-02	7.11E-04	3.83E-03	5.22E-04	3.08E-03	1.38E-03	6.80E-03	4.08E-03	9.98E-03	3.21E-03	8.08E-03
Trunk	1.14E-07	1.00E-06	1.65E-07	9.59E-07	5.51E-08	4.01E-07	3.42E-08	1.94E-06	3.48E-07	2.03E-06	2.97E-07	5.60E-07
White Matter	1.31E-07	1.12E-06	1.64E-07	1.24E-06	1.07E-08	5.04E-07	8.27E-09	2.55E-06	4.40E-07	2.69E-06	3.75E-07	7.23E-07

Table B.56: S values for the 10-year-old Phantom for Sources Located in the White Matter.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.04E-05	8.35E-05	1.14E-04	5.35E-05	8.76E-05	4.72E-04	1.84E-04	1.96E-05	2.23E-05	1.30E-04	2.00E-04	3.20E-05
Caud. Nucl.	3.93E-05	4.40E-05	5.99E-05	3.51E-05	2.51E-05	5.84E-04	1.22E-04	7.08E-06	4.40E-06	1.19E-04	1.45E-04	2.85E-06
Cerebellum	8.69E-06	8.70E-06	8.73E-06	8.71E-06	2.88E-08	1.55E-05	8.76E-06	1.61E-06	1.01E-06	1.99E-05	9.59E-06	2.34E-08
Cereb. Cort.	1.72E-05	1.85E-05	2.32E-05	1.60E-05	7.34E-06	2.04E-04	4.24E-05	3.13E-06	1.98E-06	4.92E-05	5.02E-05	8.37E-07
Cranium	9.11E-06	9.13E-06	9.16E-06	9.12E-06	5.24E-08	2.52E-05	9.40E-06	1.69E-06	1.41E-06	2.12E-05	1.05E-05	2.91E-08
Eyes	7.08E-06	7.08E-06	7.10E-06	7.09E-06	2.28E-08	7.88E-06	7.03E-06	1.31E-06	7.69E-07	1.61E-05	7.56E-06	1.80E-08
Lent. Nucl.	3.21E-05	3.53E-05	4.62E-05	2.93E-05	1.72E-05	4.24E-04	8.91E-05	5.84E-06	3.79E-06	9.44E-05	1.05E-04	2.03E-06
Mandible	3.11E-06	3.12E-06	3.13E-06	3.12E-06	1.19E-08	3.53E-06	3.10E-06	5.77E-07	4.73E-07	7.43E-06	3.36E-06	8.53E-09
Other Tissues	2.99E-06	2.99E-06	3.00E-06	2.99E-06	8.21E-09	3.38E-06	2.97E-06	5.54E-07	3.31E-07	7.01E-06	3.22E-06	7.62E-09
Skin	4.35E-06	4.36E-06	4.37E-06	4.36E-06	1.17E-08	5.01E-06	4.33E-06	8.05E-07	4.50E-07	9.88E-06	4.67E-06	1.11E-08
Spinal Col.	1.97E-06	1.97E-06	1.98E-06	1.97E-06	5.44E-09	2.20E-06	1.96E-06	3.65E-07	2.53E-07	4.67E-06	2.12E-06	4.87E-09
Spinal Skel.	2.10E-06	2.10E-06	2.11E-06	2.10E-06	9.24E-09	2.34E-06	2.10E-06	3.89E-07	3.37E-07	4.70E-06	2.26E-06	6.01E-09
Thalami	3.21E-05	3.50E-05	4.47E-05	2.95E-05	1.55E-05	4.17E-04	8.38E-05	5.83E-06	3.81E-06	9.27E-05	9.94E-05	1.84E-06
Thyroid	1.08E-06	1.08E-06	1.08E-06	1.08E-06	2.70E-09	1.18E-06	1.07E-06	2.02E-07	1.09E-07	2.91E-06	1.17E-06	2.61E-09
Trunk	2.35E-08	2.35E-08	2.36E-08	2.35E-08	5.02E-11	2.64E-08	2.33E-08	4.42E-09	1.69E-09	7.83E-08	2.57E-08	5.61E-11
White Matter	1.47E-04	1.77E-04	2.45E-04	1.08E-04	2.03E-04	8.72E-04	3.88E-04	4.32E-05	5.14E-05	2.46E-04	4.18E-04	7.67E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.76E-06	1.53E-04	8.56E-06	4.64E-05	5.74E-06	8.14E-05	3.25E-05	1.07E-04	1.89E-05	1.05E-05	8.17E-06	1.75E-05
Caud. Nucl.	4.11E-06	1.07E-04	7.50E-06	4.07E-05	4.88E-06	6.96E-05	1.36E-05	8.12E-05	3.18E-06	3.14E-06	3.89E-06	7.74E-06
Cerebellum	1.11E-06	8.16E-06	1.72E-06	8.57E-06	7.59E-07	1.76E-05	3.25E-06	1.81E-05	6.28E-07	7.67E-07	9.82E-07	2.05E-06
Cereb. Cort.	1.95E-06	3.75E-05	3.37E-06	1.77E-05	1.95E-06	3.22E-05	6.15E-06	3.61E-05	1.35E-06	1.42E-06	1.78E-06	3.67E-06
Cranium	1.67E-06	8.97E-06	3.17E-06	9.66E-06	2.47E-06	1.85E-05	3.63E-06	1.89E-05	1.73E-06	1.92E-06	2.26E-06	2.47E-06
Eyes	8.23E-07	6.47E-06	1.09E-06	6.76E-06	1.87E-07	1.41E-05	2.61E-06	1.44E-05	2.87E-07	4.47E-07	6.04E-07	1.63E-06
Lent. Nucl.	3.61E-06	7.83E-05	6.44E-06	3.32E-05	4.00E-06	5.86E-05	1.15E-05	6.71E-05	2.68E-06	2.71E-06	3.38E-06	6.76E-06
Mandible	5.61E-07	2.88E-06	6.90E-07	3.11E-06	1.63E-07	6.42E-06	1.23E-06	6.65E-06	2.73E-07	4.55E-07	5.63E-07	8.34E-07
Other Tissues	3.62E-07	2.75E-06	4.81E-07	2.95E-06	9.67E-08	6.14E-06	1.11E-06	6.38E-06	1.39E-07	2.12E-07	2.82E-07	6.87E-07
Skin	4.82E-07	4.00E-06	6.80E-07	4.21E-06	1.75E-07	8.80E-06	1.59E-06	9.05E-06	1.98E-07	2.76E-07	3.69E-07	9.67E-07
Spinal Col.	2.78E-07	1.81E-06	3.54E-07	1.94E-06	5.51E-08	4.03E-06	7.64E-07	4.16E-06	9.35E-08	1.47E-07	1.99E-07	4.99E-07
Spinal Skel.	4.04E-07	1.94E-06	4.94E-07	2.03E-06	1.24E-07	4.23E-06	8.37E-07	4.31E-06	2.06E-07	3.44E-07	4.21E-07	5.80E-07
Thalami	3.70E-06	7.39E-05	6.57E-06	3.30E-05	4.06E-06	5.90E-05	1.15E-05	6.67E-05	2.72E-06	2.77E-06	3.46E-06	6.87E-06
Thyroid	1.17E-07	9.97E-07	1.48E-07	1.17E-06	9.73E-09	2.36E-06	3.94E-07	2.55E-06	3.10E-08	5.43E-08	7.64E-08	2.37E-07
Trunk	1.75E-09	2.19E-08	2.30E-09	2.86E-08	3.53E-11	5.38E-08	7.96E-09	6.05E-08	3.53E-10	6.51E-10	9.78E-10	4.24E-09
White Matter	8.77E-06	3.21E-04	1.60E-05	8.78E-05	1.12E-05	1.52E-04	7.04E-05	2.10E-04	4.42E-05	2.36E-05	1.73E-05	3.74E-05

S Values in a Mathematical Model of the Head and Brain of a Fifteen-Year-Old

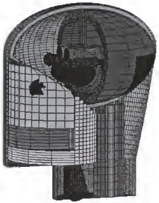


Table B.57: S values for the 15-year-old Phantom for Sources Located in the Brain (total).

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.58E-05	7.81E-05	1.07E-04	4.97E-05	8.30E-05	4.12E-04	1.70E-04	1.85E-05	2.12E-05	1.18E-04	1.84E-04	3.07E-05
Caud. Nucl.	7.12E-05	8.39E-05	1.13E-04	5.49E-05	8.45E-05	4.62E-04	1.79E-04	1.95E-05	2.19E-05	1.31E-04	1.95E-04	3.09E-05
Cerebellum	6.43E-05	7.66E-05	1.05E-04	4.83E-05	8.26E-05	3.98E-04	1.66E-04	1.82E-05	2.11E-05	1.14E-04	1.80E-04	3.07E-05
Cereb. Cort.	6.31E-05	7.52E-05	1.03E-04	4.74E-05	8.14E-05	3.69E-04	1.62E-04	1.80E-05	2.09E-05	1.10E-04	1.74E-04	3.04E-05
Cranium	1.04E-05	1.09E-05	1.29E-05	1.02E-05	2.47E-06	1.14E-04	2.33E-05	1.90E-06	1.52E-06	3.03E-05	2.78E-05	8.49E-08
Eyes	5.80E-06	5.81E-06	5.82E-06	5.81E-06	1.54E-08	7.08E-06	5.77E-06	1.07E-06	6.04E-07	1.32E-05	6.25E-06	1.45E-08
Lent. Nucl.	7.04E-05	8.31E-05	1.13E-04	5.41E-05	8.49E-05	4.65E-04	1.80E-04	1.94E-05	2.18E-05	1.30E-04	1.97E-04	3.10E-05
Mandible	2.87E-06	2.88E-06	2.89E-06	2.88E-06	1.13E-08	3.99E-06	2.88E-06	5.33E-07	4.35E-07	6.81E-06	3.14E-06	7.96E-09
Other Tissues	2.85E-06	2.86E-06	2.86E-06	2.86E-06	8.18E-09	5.52E-06	2.89E-06	5.28E-07	3.15E-07	6.74E-06	3.17E-06	7.25E-09
Skin	4.31E-06	4.32E-06	4.33E-06	4.32E-06	1.12E-08	1.88E-05	4.58E-06	7.98E-07	4.42E-07	1.02E-05	5.26E-06	1.09E-08
Spinal Col.	2.30E-06	2.31E-06	2.31E-06	2.31E-06	6.81E-09	4.03E-06	2.32E-06	4.28E-07	2.74E-07	5.53E-06	2.55E-06	5.50E-09
Spinal Skel.	2.30E-06	2.30E-06	2.31E-06	2.30E-06	9.96E-09	3.72E-06	2.32E-06	4.26E-07	3.66E-07	5.30E-06	2.52E-06	6.36E-09
Thalami	5.60E-05	6.60E-05	8.93E-05	4.32E-05	6.69E-05	3.68E-04	1.42E-04	1.54E-05	1.74E-05	1.03E-04	1.55E-04	2.45E-05
Thyroid	9.88E-07	9.89E-07	9.90E-07	9.90E-07	1.51E-09	1.13E-06	9.82E-07	1.84E-07	9.80E-08	2.68E-06	1.07E-06	2.26E-09
Trunk	1.59E-08	1.59E-08	1.60E-08	1.60E-08	2.82E-11	1.81E-08	1.59E-08	3.00E-09	1.13E-09	5.54E-08	1.76E-08	3.75E-11
White Matter	6.84E-05	8.11E-05	1.11E-04	5.21E-05	8.48E-05	4.57E-04	1.78E-04	1.90E-05	2.16E-05	1.26E-04	1.94E-04	3.10E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.35E-06	1.41E-04	7.79E-06	4.25E-05	5.20E-06	7.47E-05	3.06E-05	9.91E-05	1.81E-05	9.97E-06	7.65E-06	1.64E-05
Caud. Nucl.	5.01E-06	1.50E-04	8.96E-06	4.78E-05	5.93E-06	8.49E-05	3.26E-05	1.10E-04	1.86E-05	1.05E-05	8.29E-06	1.77E-05
Cerebellum	4.14E-06	1.38E-04	7.42E-06	4.08E-05	4.98E-06	7.16E-05	3.01E-05	9.57E-05	1.79E-05	9.84E-06	7.46E-06	1.61E-05
Cereb. Cort.	4.04E-06	1.34E-04	7.23E-06	3.98E-05	4.82E-06	7.00E-05	2.96E-05	9.37E-05	1.78E-05	9.73E-06	7.36E-06	1.59E-05
Cranium	1.82E-06	2.11E-05	3.69E-06	1.18E-05	3.11E-06	2.08E-05	4.04E-06	2.25E-05	1.97E-06	2.09E-06	2.46E-06	2.70E-06
Eyes	6.38E-07	5.32E-06	8.45E-07	5.56E-06	1.22E-07	1.18E-05	2.13E-06	1.22E-05	2.08E-07	3.32E-07	4.54E-07	1.30E-06
Lent. Nucl.	4.89E-06	1.50E-04	8.73E-06	4.70E-05	5.78E-06	8.28E-05	3.23E-05	1.08E-04	1.84E-05	1.04E-05	8.18E-06	1.74E-05
Mandible	5.16E-07	2.67E-06	6.30E-07	2.86E-06	1.42E-07	5.92E-06	1.13E-06	6.14E-06	2.44E-07	4.09E-07	5.08E-07	7.67E-07
Other Tissues	3.43E-07	2.67E-06	4.59E-07	2.81E-06	9.52E-08	5.83E-06	1.06E-06	6.04E-06	1.31E-07	1.98E-07	2.64E-07	6.56E-07
Skin	4.72E-07	4.28E-06	6.73E-07	4.21E-06	1.81E-07	8.78E-06	1.57E-06	9.07E-06	1.96E-07	2.71E-07	3.61E-07	9.54E-07
Spinal Col.	3.10E-07	2.15E-06	3.91E-07	2.31E-06	6.46E-08	4.77E-06	8.63E-07	4.98E-06	1.09E-07	1.70E-07	2.28E-07	5.44E-07
Spinal Skel.	4.34E-07	2.15E-06	5.46E-07	2.26E-06	1.52E-07	4.65E-06	9.19E-07	4.78E-06	2.28E-07	3.72E-07	4.57E-07	6.37E-07
Thalami	4.04E-06	1.18E-04	7.14E-06	3.76E-05	4.68E-06	6.69E-05	2.58E-05	8.69E-05	1.48E-05	8.37E-06	6.63E-06	1.40E-05
Thyroid	1.04E-07	9.13E-07	1.30E-07	1.05E-06	5.31E-09	2.16E-06	3.59E-07	2.32E-06	2.74E-08	5.23E-08	7.20E-08	2.15E-07
Trunk	1.17E-09	1.49E-08	1.54E-09	2.00E-08	1.71E-11	3.73E-08	5.40E-09	4.23E-08	2.25E-10	4.13E-10	6.31E-10	2.85E-09
White Matter	4.65E-06	1.49E-04	8.34E-06	4.52E-05	5.57E-06	7.94E-05	3.16E-05	1.05E-04	1.83E-05	1.02E-05	7.95E-06	1.70E-05

Table B.58: S values for the 15-year-old Phantom for Sources Located in the Caudate Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.09E-05	8.36E-05	1.13E-04	5.46E-05	8.46E-05	4.64E-04	1.80E-04	1.94E-05	2.19E-05	1.32E-04	1.97E-04	3.09E-05
Caud. Nucl.	6.14E-03	7.51E-03	1.03E-02	4.26E-03	9.52E-03	1.91E-02	1.50E-02	1.98E-03	2.51E-03	7.87E-03	1.55E-02	3.90E-03
Cerebellum	6.19E-06	6.20E-06	6.22E-06	6.21E-06	2.03E-08	6.84E-06	6.16E-06	1.15E-06	7.32E-07	1.41E-05	6.64E-06	1.61E-08
Cereb. Cort.	1.17E-05	1.17E-05	1.18E-05	1.17E-05	3.98E-08	1.42E-05	1.17E-05	2.17E-06	1.40E-06	2.67E-05	1.26E-05	3.15E-08
Cranium	7.82E-06	7.83E-06	7.86E-06	7.83E-06	4.39E-08	8.77E-06	7.82E-06	1.45E-06	1.29E-06	1.78E-05	8.44E-06	2.46E-08
Eyes	7.95E-06	7.96E-06	7.98E-06	7.97E-06	2.29E-08	8.87E-06	7.91E-06	1.47E-06	8.92E-07	1.85E-05	8.55E-06	2.15E-08
Lent. Nucl.	1.34E-04	1.68E-04	2.82E-04	1.03E-04	1.82E-04	3.35E-03	7.03E-04	2.38E-05	1.57E-05	5.06E-04	8.34E-04	2.11E-05
Mandible	3.83E-06	3.84E-06	3.85E-06	3.84E-06	1.37E-08	4.26E-06	3.82E-06	7.09E-07	5.83E-07	8.77E-06	4.11E-06	1.06E-08
Other Tissues	2.91E-06	2.91E-06	2.92E-06	2.91E-06	8.29E-09	3.20E-06	2.89E-06	5.38E-07	3.32E-07	6.78E-06	3.12E-06	7.42E-09
Skin	3.54E-06	3.54E-06	3.55E-06	3.55E-06	9.93E-09	3.90E-06	3.52E-06	6.56E-07	3.72E-07	8.24E-06	3.80E-06	9.16E-09
Spinal Col.	1.58E-06	1.58E-06	1.59E-06	1.58E-06	6.93E-09	1.69E-06	1.57E-06	2.92E-07	1.96E-07	3.34E-06	1.68E-06	4.75E-09
Spinal Skel.	1.61E-06	1.62E-06	1.62E-06	1.62E-06	7.12E-09	1.79E-06	1.61E-06	2.98E-07	2.92E-07	3.58E-06	1.73E-06	4.79E-09
Thalami	4.55E-05	4.83E-05	6.16E-05	4.36E-05	1.68E-05	1.04E-03	1.42E-04	8.22E-06	5.05E-06	1.53E-04	1.79E-04	8.26E-07
Thyroid	1.24E-06	1.24E-06	1.24E-06	1.24E-06	2.24E-09	1.40E-06	1.23E-06	2.30E-07	1.21E-07	3.00E-06	1.34E-06	3.01E-09
Trunk	1.77E-08	1.77E-08	1.78E-08	1.77E-08	3.60E-11	2.00E-08	1.76E-08	3.34E-09	1.26E-09	6.12E-08	1.95E-08	4.24E-11
White Matter	3.70E-05	4.15E-05	5.64E-05	3.31E-05	2.36E-05	5.51E-04	1.14E-04	6.70E-06	4.35E-06	1.13E-04	1.36E-04	2.72E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.02E-06	1.51E-04	8.97E-06	4.77E-05	5.94E-06	8.45E-05	3.25E-05	1.10E-04	1.85E-05	1.05E-05	8.28E-06	1.76E-05
Caud. Nucl.	2.96E-04	1.21E-02	5.41E-04	2.95E-03	3.96E-04	5.21E-03	3.15E-03	7.70E-03	2.19E-03	1.11E-03	7.54E-04	1.65E-03
Cerebellum	8.07E-07	5.70E-06	1.13E-06	6.02E-06	3.48E-07	1.25E-05	2.32E-06	1.28E-05	3.87E-07	5.42E-07	6.98E-07	1.47E-06
Cereb. Cort.	1.54E-06	1.09E-05	2.39E-06	1.16E-05	1.07E-06	2.37E-05	4.42E-06	2.44E-05	8.87E-07	1.07E-06	1.37E-06	2.81E-06
Cranium	1.53E-06	7.37E-06	2.52E-06	8.08E-06	1.61E-06	1.59E-05	3.15E-06	1.63E-05	1.36E-06	1.72E-06	2.03E-06	2.19E-06
Eyes	9.73E-07	7.29E-06	1.25E-06	7.78E-06	1.81E-07	1.63E-05	2.95E-06	1.69E-05	3.37E-07	5.51E-07	7.36E-07	1.84E-06
Lent. Nucl.	1.10E-05	6.03E-04	2.21E-05	1.45E-04	1.67E-05	2.05E-04	4.32E-05	2.84E-04	1.08E-05	9.30E-06	1.11E-05	2.19E-05
Mandible	6.97E-07	3.52E-06	8.43E-07	3.72E-06	1.88E-07	7.73E-06	1.50E-06	7.92E-06	3.33E-07	5.61E-07	6.94E-07	1.02E-06
Other Tissues	3.62E-07	2.67E-06	4.69E-07	2.84E-06	7.66E-08	5.93E-06	1.08E-06	6.13E-06	1.30E-07	2.08E-07	2.77E-07	6.80E-07
Skin	4.00E-07	3.25E-06	5.32E-07	3.46E-06	9.25E-08	7.23E-06	1.29E-06	7.48E-06	1.42E-07	2.20E-07	2.97E-07	7.91E-07
Spinal Col.	2.08E-07	1.44E-06	2.62E-07	1.45E-06	2.61E-08	3.08E-06	6.06E-07	3.09E-06	6.34E-08	1.10E-07	1.49E-07	3.97E-07
Spinal Skel.	3.55E-07	1.48E-06	4.02E-07	1.53E-06	6.37E-08	3.20E-06	6.66E-07	3.23E-06	1.57E-07	2.83E-07	3.51E-07	4.81E-07
Thalami	5.56E-06	1.27E-04	1.06E-05	4.99E-05	7.33E-06	8.79E-05	1.65E-05	9.79E-05	4.11E-06	4.16E-06	5.20E-06	1.02E-05
Thyroid	1.30E-07	1.14E-06	1.62E-07	1.24E-06	8.99E-09	2.54E-06	4.43E-07	2.66E-06	3.49E-08	6.33E-08	8.77E-08	2.64E-07
Trunk	1.31E-09	1.66E-08	1.72E-09	2.21E-08	2.20E-11	4.11E-08	6.00E-09	4.65E-08	2.59E-10	4.74E-10	7.19E-10	3.18E-09
White Matter	4.05E-06	1.00E-04	7.36E-06	3.87E-05	4.75E-06	6.65E-05	1.30E-05	7.79E-05	3.12E-06	3.07E-06	3.81E-06	7.57E-06

Table B.59: S values for the 15-year-old Phantom for Sources Located in the Cerebellum.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.41E-05	7.63E-05	1.05E-04	4.81E-05	8.24E-05	3.97E-04	1.66E-04	1.82E-05	2.10E-05	1.13E-04	1.80E-04	3.06E-05
Caud. Nucl.	6.14E-06	6.15E-06	6.17E-06	6.15E-06	2.29E-08	6.80E-06	6.11E-06	1.14E-06	7.48E-07	1.39E-05	6.58E-06	1.59E-08
Cerebellum	5.45E-04	6.64E-04	9.32E-04	3.89E-04	8.05E-04	3.28E-03	1.49E-03	1.65E-04	2.00E-04	8.82E-04	1.60E-03	3.05E-04
Cereb. Cort.	1.34E-05	1.44E-05	1.78E-05	1.25E-05	5.34E-06	1.47E-04	3.14E-05	2.44E-06	1.54E-06	3.77E-05	3.71E-05	6.16E-07
Cranium	1.12E-05	1.17E-05	1.43E-05	1.08E-05	3.17E-06	1.46E-04	2.79E-05	2.02E-06	1.61E-06	3.41E-05	3.37E-05	9.46E-08
Eyes	1.47E-06	1.47E-06	1.48E-06	1.47E-06	3.23E-09	1.61E-06	1.46E-06	2.72E-07	1.49E-07	3.48E-06	1.57E-06	3.39E-09
Lent. Nucl.	6.63E-06	6.64E-06	6.65E-06	6.64E-06	1.77E-08	7.32E-06	6.59E-06	1.23E-06	8.02E-07	1.51E-05	7.11E-06	1.70E-08
Mandible	1.88E-06	1.88E-06	1.88E-06	1.88E-06	6.22E-09	2.08E-06	1.87E-06	3.47E-07	2.74E-07	4.51E-06	2.02E-06	5.14E-09
Other Tissues	3.65E-06	3.66E-06	3.67E-06	3.66E-06	1.04E-08	9.42E-06	3.74E-06	6.77E-07	3.97E-07	8.64E-06	4.16E-06	9.35E-09
Skin	4.34E-06	4.35E-06	4.36E-06	4.35E-06	1.23E-08	1.70E-05	4.57E-06	8.04E-07	4.49E-07	1.02E-05	5.21E-06	1.11E-08
Spinal Col.	4.62E-06	4.63E-06	4.64E-06	4.63E-06	1.34E-08	5.99E-06	4.62E-06	8.56E-07	4.85E-07	1.10E-05	5.03E-06	1.15E-08
Spinal Skel.	4.51E-06	4.51E-06	4.53E-06	4.51E-06	1.93E-08	7.80E-06	4.55E-06	8.34E-07	6.65E-07	1.05E-05	4.97E-06	1.27E-08
Thalami	7.92E-06	7.93E-06	7.95E-06	7.93E-06	2.77E-08	8.76E-06	7.88E-06	1.47E-06	9.43E-07	1.78E-05	8.49E-06	2.10E-08
Thyroid	1.03E-06	1.03E-06	1.03E-06	1.03E-06	1.11E-09	1.16E-06	1.02E-06	1.92E-07	8.86E-08	2.70E-06	1.11E-06	2.36E-09
Trunk	1.88E-08	1.88E-08	1.88E-08	1.88E-08	3.18E-11	2.13E-08	1.87E-08	3.54E-09	1.30E-09	6.42E-08	2.06E-08	4.45E-11
White Matter	8.54E-06	8.55E-06	8.58E-06	8.56E-06	2.93E-08	1.51E-05	8.61E-06	1.58E-06	1.01E-06	1.96E-05	9.42E-06	2.30E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.15E-06	1.38E-04	7.43E-06	4.07E-05	4.98E-06	7.15E-05	3.00E-05	9.56E-05	1.79E-05	9.82E-06	7.46E-06	1.61E-05
Caud. Nucl.	8.38E-07	5.65E-06	1.16E-06	5.96E-06	3.60E-07	1.24E-05	2.31E-06	1.27E-05	4.02E-07	5.59E-07	7.20E-07	1.48E-06
Cerebellum	2.98E-05	1.23E-03	5.53E-05	3.10E-04	4.03E-05	5.27E-04	2.65E-04	7.54E-04	1.73E-04	9.03E-05	6.43E-05	1.39E-04
Cereb. Cort.	1.53E-06	2.78E-05	2.60E-06	1.38E-05	1.46E-06	2.53E-05	4.81E-06	2.82E-05	1.03E-06	1.09E-06	1.38E-06	2.87E-06
Cranium	1.92E-06	2.52E-05	4.06E-06	1.29E-05	3.57E-06	2.22E-05	4.30E-06	2.44E-05	2.17E-06	2.24E-06	2.62E-06	2.88E-06
Eyes	1.57E-07	1.34E-06	1.96E-07	1.43E-06	5.26E-09	2.97E-06	5.36E-07	3.07E-06	3.56E-08	6.64E-08	9.59E-08	3.27E-07
Lent. Nucl.	8.92E-07	6.10E-06	1.24E-06	6.46E-06	3.78E-07	1.33E-05	2.50E-06	1.37E-05	4.28E-07	6.04E-07	7.76E-07	1.59E-06
Mandible	3.25E-07	1.72E-06	3.70E-07	1.85E-06	3.82E-08	3.84E-06	7.31E-07	3.97E-06	1.22E-07	2.25E-07	2.86E-07	4.90E-07
Other Tissues	4.30E-07	3.48E-06	5.92E-07	3.60E-06	1.43E-07	7.47E-06	1.35E-06	7.74E-06	1.75E-07	2.53E-07	3.36E-07	8.33E-07
Skin	4.77E-07	4.26E-06	6.92E-07	4.26E-06	1.99E-07	8.86E-06	1.59E-06	9.15E-06	2.05E-07	2.73E-07	3.65E-07	9.69E-07
Spinal Col.	5.07E-07	4.27E-06	6.98E-07	4.59E-06	1.36E-07	9.67E-06	1.71E-06	1.01E-05	1.88E-07	2.88E-07	3.87E-07	1.05E-06
Spinal Skel.	7.93E-07	4.23E-06	1.02E-06	4.46E-06	3.22E-07	9.15E-06	1.75E-06	9.41E-06	4.46E-07	7.08E-07	8.63E-07	1.17E-06
Thalami	1.05E-06	7.30E-06	1.53E-06	7.74E-06	5.81E-07	1.60E-05	2.97E-06	1.64E-05	5.68E-07	7.56E-07	9.60E-07	1.89E-06
Thyroid	9.86E-08	9.46E-07	1.20E-07	1.08E-06	4.00E-09	2.14E-06	3.54E-07	2.27E-06	2.45E-08	4.40E-08	6.20E-08	2.00E-07
Trunk	1.34E-09	1.76E-08	1.77E-09	2.32E-08	1.31E-11	4.31E-08	6.33E-09	4.85E-08	2.45E-10	4.46E-10	6.95E-10	3.34E-09
White Matter	1.12E-06	8.02E-06	1.72E-06	8.46E-06	7.49E-07	1.73E-05	3.22E-06	1.78E-05	6.28E-07	7.72E-07	9.88E-07	2.04E-06

Table B.60: S values for the 15-year-old Phantom for Sources Located in the Cerebral Cortex.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.31E-05	7.52E-05	1.03E-04	4.74E-05	8.14E-05	3.69E-04	1.62E-04	1.80E-05	2.09E-05	1.10E-04	1.74E-04	3.05E-05
Caud. Nucl.	1.17E-05	1.17E-05	1.17E-05	1.17E-05	4.10E-08	1.41E-05	1.17E-05	2.16E-06	1.42E-06	2.65E-05	1.26E-05	3.11E-08
Cerebellum	1.35E-05	1.45E-05	1.79E-05	1.26E-05	5.35E-06	1.47E-04	3.15E-05	2.46E-06	1.55E-06	3.78E-05	3.71E-05	6.27E-07
Cereb. Cort.	1.24E-04	1.51E-04	2.09E-04	8.95E-05	1.79E-04	6.21E-04	3.23E-04	3.76E-05	4.56E-05	1.94E-04	3.43E-04	6.90E-05
Cranium	1.20E-05	1.28E-05	1.68E-05	1.14E-05	4.90E-06	2.04E-04	3.74E-05	2.14E-06	1.65E-06	4.01E-05	4.54E-05	1.41E-07
Eyes	5.99E-06	6.00E-06	6.01E-06	6.00E-06	1.55E-08	7.89E-06	5.98E-06	1.11E-06	5.99E-07	1.33E-05	6.44E-06	1.43E-08
Lent. Nucl.	1.16E-05	1.17E-05	1.18E-05	1.17E-05	1.09E-07	5.01E-05	1.31E-05	2.16E-06	1.42E-06	2.79E-05	1.50E-05	3.16E-08
Mandible	2.82E-06	2.82E-06	2.83E-06	2.82E-06	1.16E-08	4.95E-06	2.85E-06	5.22E-07	4.10E-07	6.64E-06	3.12E-06	8.13E-09
Other Tissues	2.69E-06	2.69E-06	2.70E-06	2.69E-06	7.44E-09	7.08E-06	2.76E-06	4.99E-07	2.94E-07	6.42E-06	3.08E-06	6.87E-09
Skin	4.72E-06	4.73E-06	4.74E-06	4.73E-06	1.29E-08	3.43E-05	5.30E-06	8.74E-07	4.81E-07	1.14E-05	6.38E-06	1.20E-08
Spinal Col.	2.30E-06	2.30E-06	2.30E-06	2.30E-06	4.32E-09	5.50E-06	2.34E-06	4.23E-07	2.50E-07	5.05E-06	2.57E-06	5.21E-09
Spinal Skel.	2.13E-06	2.14E-06	2.14E-06	2.14E-06	8.36E-09	4.30E-06	2.16E-06	3.95E-07	3.35E-07	4.98E-06	2.38E-06	5.90E-09
Thalami	9.44E-06	9.46E-06	9.48E-06	9.46E-06	3.35E-08	1.51E-05	9.48E-06	1.75E-06	1.13E-06	2.17E-05	1.03E-05	2.67E-08
Thyroid	8.96E-07	8.97E-07	8.98E-07	8.98E-07	1.05E-09	9.92E-07	8.90E-07	1.67E-07	9.15E-08	2.42E-06	9.68E-07	2.07E-09
Trunk	1.48E-08	1.48E-08	1.49E-08	1.48E-08	2.95E-11	1.68E-08	1.47E-08	2.79E-09	1.00E-09	5.05E-08	1.63E-08	3.63E-11
White Matter	1.67E-05	1.80E-05	2.25E-05	1.56E-05	7.03E-06	1.96E-04	4.09E-05	3.05E-06	1.94E-06	4.79E-05	4.84E-05	8.07E-07

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.05E-06	1.34E-04	7.23E-06	3.97E-05	4.82E-06	7.00E-05	2.97E-05	9.36E-05	1.78E-05	9.73E-06	7.36E-06	1.59E-05
Caud. Nucl.	1.56E-06	1.08E-05	2.43E-06	1.15E-05	1.09E-06	2.34E-05	4.43E-06	2.40E-05	9.07E-07	1.11E-06	1.41E-06	2.84E-06
Cerebellum	1.54E-06	2.79E-05	2.61E-06	1.38E-05	1.45E-06	2.54E-05	4.85E-06	2.83E-05	1.02E-06	1.09E-06	1.38E-06	2.89E-06
Cereb. Cort.	6.92E-06	2.65E-04	1.26E-05	7.01E-05	8.79E-06	1.22E-04	6.06E-05	1.72E-04	3.92E-05	2.06E-05	1.47E-05	3.20E-05
Cranium	1.97E-06	3.34E-05	4.30E-06	1.42E-05	3.89E-06	2.35E-05	4.51E-06	2.65E-05	2.28E-06	2.30E-06	2.69E-06	2.98E-06
Eyes	6.44E-07	5.49E-06	8.47E-07	5.62E-06	1.27E-07	1.17E-05	2.15E-06	1.18E-05	2.18E-07	3.48E-07	4.71E-07	1.30E-06
Lent. Nucl.	1.59E-06	1.22E-05	2.51E-06	1.17E-05	1.20E-06	2.37E-05	4.43E-06	2.45E-05	9.36E-07	1.11E-06	1.41E-06	2.83E-06
Mandible	4.86E-07	2.64E-06	6.06E-07	2.79E-06	1.52E-07	5.70E-06	1.09E-06	5.87E-06	2.37E-07	3.85E-07	4.78E-07	7.33E-07
Other Tissues	3.18E-07	2.57E-06	4.32E-07	2.66E-06	9.43E-08	5.52E-06	9.93E-07	5.73E-06	1.23E-07	1.83E-07	2.44E-07	6.15E-07
Skin	5.12E-07	4.99E-06	7.45E-07	4.63E-06	2.18E-07	9.67E-06	1.72E-06	1.00E-05	2.20E-07	2.93E-07	3.92E-07	1.04E-06
Spinal Col.	2.73E-07	2.16E-06	3.53E-07	2.08E-06	5.39E-08	4.38E-06	8.39E-07	4.36E-06	9.03E-08	1.41E-07	1.93E-07	5.23E-07
Spinal Skel.	4.02E-07	2.01E-06	5.11E-07	2.12E-06	1.56E-07	4.35E-06	8.45E-07	4.48E-06	2.17E-07	3.44E-07	4.21E-07	5.79E-07
Thalami	1.25E-06	8.83E-06	1.95E-06	9.35E-06	8.83E-07	1.91E-05	3.56E-06	1.96E-05	7.35E-07	8.94E-07	1.14E-06	2.26E-06
Thyroid	1.00E-07	8.25E-07	1.22E-07	9.58E-07	5.13E-09	1.90E-06	3.25E-07	2.04E-06	2.49E-08	4.45E-08	6.31E-08	1.95E-07
Trunk	1.04E-09	1.38E-08	1.37E-09	1.83E-08	1.50E-11	3.42E-08	4.96E-09	3.85E-08	2.02E-10	3.69E-10	5.63E-10	2.59E-09
White Matter	1.92E-06	3.62E-05	3.31E-06	1.73E-05	1.90E-06	3.15E-05	6.02E-06	3.53E-05	1.32E-06	1.40E-06	1.76E-06	3.60E-06

Table B.61: S values for the 15-year-old Phantom for Sources Located in the Cranial CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.17E-05	2.67E-05	3.98E-05	1.62E-05	2.58E-05	2.01E-04	7.12E-05	4.08E-06	2.79E-06	5.62E-05	7.92E-05	4.65E-06
Caud. Nucl.	8.78E-06	8.79E-06	8.82E-06	8.80E-06	3.51E-08	9.72E-06	8.74E-06	1.62E-06	1.04E-06	1.99E-05	9.44E-06	2.32E-08
Cerebellum	2.60E-05	3.29E-05	5.06E-05	1.87E-05	3.49E-05	2.61E-04	9.31E-05	4.90E-06	3.37E-06	6.85E-05	1.03E-04	6.23E-06
Cereb. Cort.	3.32E-05	4.32E-05	6.91E-05	2.24E-05	5.12E-05	3.52E-04	1.31E-04	6.29E-06	4.41E-06	8.83E-05	1.45E-04	9.21E-06
Cranium	4.91E-05	6.66E-05	1.13E-04	3.02E-05	9.00E-05	4.79E-04	2.19E-04	9.28E-06	7.09E-06	1.32E-04	2.40E-04	1.59E-05
Eyes	6.08E-06	6.09E-06	6.10E-06	6.09E-06	1.68E-08	1.23E-05	6.15E-06	1.12E-06	6.19E-07	1.41E-05	6.75E-06	1.46E-08
Lent. Nucl.	9.51E-06	9.52E-06	9.54E-06	9.53E-06	2.99E-08	1.82E-05	9.62E-06	1.76E-06	1.09E-06	2.12E-05	1.05E-05	2.53E-08
Mandible	2.99E-06	2.99E-06	3.00E-06	2.99E-06	1.44E-08	8.83E-06	3.20E-06	5.53E-07	4.28E-07	7.25E-06	3.59E-06	8.32E-09
Other Tissues	3.16E-06	3.16E-06	3.17E-06	3.16E-06	1.16E-08	2.05E-05	3.68E-06	5.85E-07	3.37E-07	7.85E-06	4.38E-06	8.11E-09
Skin	5.56E-06	5.56E-06	5.59E-06	5.57E-06	2.60E-08	9.26E-05	8.92E-06	1.03E-06	5.54E-07	1.53E-05	1.18E-05	1.42E-08
Spinal Col.	2.88E-06	2.88E-06	2.89E-06	2.88E-06	8.13E-09	1.62E-05	3.19E-06	5.32E-07	2.99E-07	6.90E-06	3.74E-06	7.80E-09
Spinal Skel.	2.66E-06	2.66E-06	2.67E-06	2.66E-06	1.15E-08	1.23E-05	2.90E-06	4.92E-07	3.89E-07	6.34E-06	3.34E-06	7.57E-09
Thalami	6.84E-06	6.85E-06	6.87E-06	6.85E-06	2.53E-08	7.71E-06	6.81E-06	1.27E-06	8.35E-07	1.57E-05	7.37E-06	1.89E-08
Thyroid	9.47E-07	9.48E-07	9.51E-07	9.49E-07	2.78E-09	1.06E-06	9.42E-07	1.76E-07	8.66E-08	2.56E-06	1.03E-06	2.32E-09
Trunk	1.52E-08	1.52E-08	1.52E-08	1.52E-08	3.05E-11	1.72E-08	1.51E-08	2.85E-09	1.06E-09	5.11E-08	1.66E-08	3.66E-11
White Matter	1.00E-05	1.00E-05	1.01E-05	1.00E-05	3.56E-08	4.92E-05	1.07E-05	1.85E-06	1.16E-06	2.38E-05	1.25E-05	2.69E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.55E-06	6.01E-05	2.67E-06	1.96E-05	1.49E-06	3.11E-05	7.12E-06	4.12E-05	1.52E-06	1.23E-06	1.48E-06	3.29E-06
Caud. Nucl.	1.13E-06	8.11E-06	1.69E-06	8.62E-06	6.44E-07	1.79E-05	3.31E-06	1.84E-05	5.85E-07	7.42E-07	9.61E-07	2.10E-06
Cerebellum	1.69E-06	7.83E-05	2.99E-06	2.33E-05	1.76E-06	3.54E-05	8.39E-06	4.89E-05	1.83E-06	1.39E-06	1.66E-06	3.68E-06
Cereb. Cort.	1.84E-06	1.09E-04	3.32E-06	2.92E-05	2.01E-06	4.19E-05	1.05E-05	6.14E-05	2.31E-06	1.60E-06	1.87E-06	4.21E-06
Cranium	2.82E-06	1.82E-04	6.73E-06	4.39E-05	6.43E-06	5.54E-05	1.52E-05	8.93E-05	5.32E-06	3.78E-06	4.20E-06	5.72E-06
Eyes	6.62E-07	5.68E-06	8.73E-07	5.84E-06	1.27E-07	1.23E-05	2.20E-06	1.26E-05	2.14E-07	3.38E-07	4.64E-07	1.34E-06
Lent. Nucl.	1.21E-06	8.93E-06	1.85E-06	9.19E-06	7.80E-07	1.90E-05	3.54E-06	1.93E-05	6.62E-07	8.20E-07	1.05E-06	2.23E-06
Mandible	5.04E-07	2.97E-06	6.41E-07	2.98E-06	1.75E-07	6.10E-06	1.16E-06	6.31E-06	2.53E-07	4.03E-07	5.00E-07	7.71E-07
Other Tissues	3.65E-07	3.44E-06	5.04E-07	3.13E-06	1.22E-07	6.46E-06	1.16E-06	6.71E-06	1.46E-07	2.09E-07	2.79E-07	7.12E-07
Skin	5.88E-07	8.42E-06	8.71E-07	5.48E-06	2.71E-07	1.13E-05	2.01E-06	1.17E-05	2.56E-07	3.31E-07	4.45E-07	1.21E-06
Spinal Col.	3.17E-07	2.98E-06	4.26E-07	2.78E-06	7.33E-08	5.83E-06	1.05E-06	6.01E-06	1.10E-07	1.72E-07	2.33E-07	6.44E-07
Spinal Skel.	4.61E-07	2.71E-06	6.04E-07	2.62E-06	2.01E-07	5.35E-06	1.03E-06	5.49E-06	2.61E-07	4.06E-07	4.95E-07	6.91E-07
Thalami	9.22E-07	6.32E-06	1.36E-06	6.77E-06	5.26E-07	1.40E-05	2.60E-06	1.45E-05	4.88E-07	6.32E-07	8.11E-07	1.66E-06
Thyroid	9.39E-08	8.76E-07	1.18E-07	1.02E-06	8.09E-09	2.08E-06	3.35E-07	2.24E-06	2.60E-08	4.57E-08	6.34E-08	1.93E-07
Trunk	1.09E-09	1.42E-08	1.45E-09	1.85E-08	1.80E-11	3.47E-08	5.12E-09	3.89E-08	2.10E-10	3.86E-10	5.91E-10	2.71E-09
White Matter	1.27E-06	1.01E-05	2.03E-06	1.00E-05	9.66E-07	2.04E-05	3.76E-06	2.10E-05	7.29E-07	8.53E-07	1.10E-06	2.37E-06

Table B.62: S values for the 15-year-old Phantom for Sources Located in the Cranium.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	2.51E-06	4.42E-10	1.65E-06	1.56E-08	6.59E-06	1.23E-06	4.66E-07	3.80E-06	8.34E-07	5.14E-07	4.46E-06	6.57E-08
Caud. Nucl.	2.63E-08	2.52E-10	1.95E-08	1.41E-09	5.52E-08	1.01E-06	2.87E-07	2.92E-06	6.18E-07	1.84E-07	4.78E-07	5.40E-08
Cerebellum	3.20E-06	4.57E-10	2.10E-06	1.46E-08	8.48E-06	1.32E-06	5.29E-07	4.06E-06	9.06E-07	5.96E-07	5.61E-06	7.05E-08
Cereb. Cort.	4.98E-06	5.96E-10	3.28E-06	2.95E-08	1.31E-05	1.36E-06	5.63E-07	4.28E-06	9.69E-07	8.27E-07	8.38E-06	7.31E-08
Cranium	2.48E-04	3.19E-05	2.13E-04	7.92E-05	3.07E-04	9.47E-06	6.51E-06	8.50E-05	1.13E-04	1.36E-04	2.72E-04	1.92E-03
Eyes	1.60E-08	8.77E-11	1.18E-08	8.82E-10	4.86E-08	6.57E-07	8.58E-08	2.17E-06	3.04E-07	1.09E-07	3.36E-07	3.65E-08
Lent. Nucl.	3.06E-08	3.76E-10	2.35E-08	2.83E-09	6.07E-08	1.05E-06	3.22E-07	3.02E-06	6.61E-07	1.95E-07	5.01E-07	5.55E-08
Mandible	3.78E-07	2.24E-09	2.72E-07	2.24E-08	7.91E-07	5.08E-07	1.37E-07	1.20E-06	4.03E-07	1.84E-07	7.17E-07	2.39E-08
Other Tissues	1.72E-06	1.11E-08	1.26E-06	1.15E-07	3.35E-06	3.85E-07	9.65E-08	1.33E-06	3.80E-07	4.79E-07	2.45E-06	2.13E-08
Skin	1.83E-05	1.18E-07	1.38E-05	1.29E-06	3.14E-05	7.16E-07	2.39E-07	3.59E-06	2.32E-06	4.86E-06	2.31E-05	4.64E-08
Spinal Col.	1.11E-06	4.45E-09	8.01E-07	6.16E-08	2.29E-06	3.48E-07	5.56E-08	1.07E-06	2.61E-07	3.04E-07	1.66E-06	1.83E-08
Spinal Skel.	8.31E-07	4.81E-09	6.07E-07	5.11E-08	1.67E-06	4.85E-07	1.66E-07	1.13E-06	4.63E-07	2.93E-07	1.30E-06	2.28E-08
Thalami	2.26E-08	2.91E-10	1.71E-08	1.65E-09	4.25E-08	8.48E-07	2.17E-07	2.46E-06	5.18E-07	1.56E-07	3.98E-07	4.39E-08
Thyroid	2.91E-09	1.16E-13	2.28E-09	2.37E-11	5.90E-09	9.44E-08	3.89E-09	3.36E-07	3.89E-08	1.54E-08	5.37E-08	5.10E-09
Trunk	3.39E-11	5.53E-14	2.66E-11	1.65E-12	6.59E-11	1.07E-09	1.24E-11	4.96E-09	3.42E-10	1.61E-10	7.98E-10	6.10E-11
White Matter	3.49E-08	2.87E-10	2.69E-08	2.82E-09	7.82E-08	1.10E-06	3.72E-07	3.35E-06	7.01E-07	2.04E-07	5.42E-07	5.84E-08

Table B.63: S values for the 15-year-old Phantom for Sources Located in the Lateral Ventricles.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.24E-05	8.51E-05	1.15E-04	5.62E-05	8.46E-05	4.66E-04	1.82E-04	1.97E-05	2.21E-05	1.35E-04	1.98E-04	3.09E-05
Caud. Nucl.	5.90E-05	5.96E-05	6.65E-05	5.89E-05	6.85E-06	1.55E-03	1.53E-04	1.09E-05	6.79E-06	1.95E-04	2.04E-04	1.98E-07
Cerebellum	9.98E-06	9.99E-06	1.00E-05	1.00E-05	3.44E-08	1.11E-05	9.93E-06	1.85E-06	1.19E-06	2.27E-05	1.07E-05	2.69E-08
Cereb. Cort.	1.42E-05	1.42E-05	1.44E-05	1.42E-05	1.60E-07	6.77E-05	1.65E-05	2.63E-06	1.69E-06	3.40E-05	1.90E-05	3.89E-08
Cranium	7.51E-06	7.53E-06	7.55E-06	7.53E-06	4.02E-08	8.42E-06	7.51E-06	1.39E-06	1.24E-06	1.71E-05	8.09E-06	2.32E-08
Eyes	5.09E-06	5.09E-06	5.11E-06	5.10E-06	1.23E-08	5.62E-06	5.06E-06	9.43E-07	5.70E-07	1.18E-05	5.46E-06	1.27E-08
Lent. Nucl.	3.78E-05	3.80E-05	3.92E-05	3.79E-05	1.21E-06	3.42E-04	5.45E-05	7.00E-06	4.46E-06	9.62E-05	6.65E-05	1.12E-07
Mandible	2.83E-06	2.83E-06	2.84E-06	2.83E-06	1.17E-08	3.15E-06	2.82E-06	5.24E-07	4.44E-07	6.63E-06	3.04E-06	7.99E-09
Other Tissues	2.57E-06	2.57E-06	2.58E-06	2.57E-06	7.04E-09	2.84E-06	2.55E-06	4.76E-07	2.92E-07	6.03E-06	2.76E-06	6.53E-09
Skin	3.55E-06	3.55E-06	3.56E-06	3.55E-06	8.77E-09	3.90E-06	3.52E-06	6.57E-07	3.65E-07	8.12E-06	3.80E-06	8.97E-09
Spinal Col.	2.27E-06	2.27E-06	2.28E-06	2.28E-06	3.33E-09	2.57E-06	2.25E-06	4.19E-07	2.43E-07	5.04E-06	2.43E-06	5.76E-09
Spinal Skel.	2.04E-06	2.04E-06	2.05E-06	2.04E-06	8.05E-09	2.25E-06	2.03E-06	3.77E-07	3.37E-07	4.58E-06	2.18E-06	5.60E-09
Thalami	4.28E-05	4.36E-05	4.78E-05	4.24E-05	4.98E-06	5.91E-04	8.09E-05	7.86E-06	4.94E-06	1.20E-04	1.01E-04	2.21E-07
Thyroid	1.01E-06	1.01E-06	1.01E-06	1.01E-06	3.07E-09	1.13E-06	1.00E-06	1.87E-07	9.62E-08	2.63E-06	1.09E-06	2.54E-09
Trunk	1.70E-08	1.70E-08	1.70E-08	1.70E-08	3.53E-11	1.92E-08	1.69E-08	3.21E-09	1.20E-09	6.10E-08	1.88E-08	4.11E-11
White Matter	3.66E-05	4.10E-05	5.58E-05	3.27E-05	2.34E-05	4.99E-04	1.11E-04	6.63E-06	4.32E-06	1.11E-04	1.31E-04	2.70E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.23E-06	1.52E-04	9.33E-06	4.93E-05	6.14E-06	8.76E-05	3.31E-05	1.13E-04	1.87E-05	1.06E-05	8.49E-06	1.80E-05
Caud. Nucl.	7.70E-06	1.41E-04	1.48E-05	6.41E-05	1.06E-05	1.20E-04	2.22E-05	1.28E-04	5.77E-06	5.69E-06	7.13E-06	1.40E-05
Cerebellum	1.32E-06	9.22E-06	1.98E-06	9.82E-06	8.06E-07	2.02E-05	3.76E-06	2.07E-05	7.29E-07	9.26E-07	1.18E-06	2.40E-06
Cereb. Cort.	1.87E-06	1.54E-05	3.02E-06	1.42E-05	1.50E-06	2.88E-05	5.37E-06	2.96E-05	1.13E-06	1.32E-06	1.68E-06	3.41E-06
Cranium	1.49E-06	7.04E-06	2.31E-06	7.65E-06	1.34E-06	1.52E-05	3.02E-06	1.55E-05	1.24E-06	1.65E-06	1.95E-06	2.11E-06
Eyes	6.10E-07	4.66E-06	7.67E-07	4.95E-06	6.46E-08	1.03E-05	1.90E-06	1.06E-05	1.73E-07	2.99E-07	4.15E-07	1.19E-06
Lent. Nucl.	4.97E-06	5.08E-05	8.95E-06	3.86E-05	5.63E-06	7.65E-05	1.43E-05	7.92E-05	3.51E-06	3.60E-06	4.56E-06	9.05E-06
Mandible	5.33E-07	2.60E-06	6.20E-07	2.78E-06	1.03E-07	5.76E-06	1.12E-06	5.94E-06	2.33E-07	4.12E-07	5.13E-07	7.69E-07
Other Tissues	3.20E-07	2.36E-06	4.08E-07	2.52E-06	5.90E-08	5.26E-06	9.54E-07	5.46E-06	1.11E-07	1.83E-07	2.44E-07	5.98E-07
Skin	3.93E-07	3.25E-06	5.23E-07	3.43E-06	9.20E-08	7.19E-06	1.29E-06	7.41E-06	1.42E-07	2.22E-07	2.98E-07	7.84E-07
Spinal Col.	2.67E-07	2.07E-06	3.37E-07	2.11E-06	4.06E-08	4.52E-06	8.27E-07	4.59E-06	8.59E-08	1.42E-07	1.93E-07	5.08E-07
Spinal Skel.	4.09E-07	1.87E-06	4.72E-07	1.95E-06	8.44E-08	4.05E-06	8.13E-07	4.11E-06	1.88E-07	3.36E-07	4.14E-07	5.68E-07
Thalami	5.50E-06	7.45E-05	1.04E-05	4.48E-05	7.00E-06	8.53E-05	1.60E-05	8.98E-05	4.05E-06	4.00E-06	5.05E-06	1.01E-05
Thyroid	1.03E-07	9.29E-07	1.29E-07	1.04E-06	5.37E-09	2.16E-06	3.61E-07	2.30E-06	2.56E-08	4.66E-08	6.60E-08	2.13E-07
Trunk	1.23E-09	1.60E-08	1.63E-09	2.17E-08	1.59E-11	4.00E-08	5.77E-09	4.56E-08	2.32E-10	4.26E-10	6.56E-10	3.05E-09
White Matter	4.02E-06	9.71E-05	7.22E-06	3.82E-05	4.56E-06	6.58E-05	1.29E-05	7.70E-05	3.08E-06	3.07E-06	3.80E-06	7.50E-06

Table B.64: S values for the 15-year-old Phantom for Sources Located in the Lentiform Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.99E-05	8.26E-05	1.12E-04	5.37E-05	8.46E-05	4.62E-04	1.79E-04	1.92E-05	2.18E-05	1.29E-04	1.96E-04	3.09E-05
Caud. Nucl.	1.33E-04	1.67E-04	2.81E-04	1.03E-04	1.81E-04	3.35E-03	7.06E-04	2.36E-05	1.56E-05	5.08E-04	8.37E-04	2.07E-05
Cerebellum	6.46E-06	6.47E-06	6.48E-06	6.47E-06	2.04E-08	7.15E-06	6.43E-06	1.20E-06	7.94E-07	1.48E-05	6.94E-06	1.70E-08
Cereb. Cort.	1.20E-05	1.20E-05	1.21E-05	1.20E-05	9.53E-08	4.88E-05	1.33E-05	2.22E-06	1.42E-06	2.82E-05	1.52E-05	3.23E-08
Cranium	8.42E-06	8.44E-06	8.47E-06	8.43E-06	4.74E-08	1.21E-05	8.47E-06	1.56E-06	1.38E-06	1.91E-05	9.18E-06	2.65E-08
Eyes	8.67E-06	8.68E-06	8.70E-06	8.69E-06	2.27E-08	9.51E-06	8.61E-06	1.60E-06	9.12E-07	1.91E-05	9.26E-06	2.23E-08
Lent. Nucl.	3.41E-03	4.17E-03	5.80E-03	2.37E-03	5.27E-03	1.44E-02	8.77E-03	1.08E-03	1.36E-03	4.73E-03	9.21E-03	2.10E-03
Mandible	5.39E-06	5.40E-06	5.41E-06	5.40E-06	2.25E-08	5.99E-06	5.37E-06	9.97E-07	8.47E-07	1.24E-05	5.80E-06	1.48E-08
Other Tissues	4.15E-06	4.15E-06	4.16E-06	4.16E-06	1.21E-08	4.60E-06	4.13E-06	7.68E-07	4.80E-07	9.58E-06	4.46E-06	1.07E-08
Skin	3.46E-06	3.47E-06	3.47E-06	3.47E-06	9.01E-09	3.81E-06	3.44E-06	6.42E-07	3.60E-07	8.05E-06	3.72E-06	8.80E-09
Spinal Col.	2.04E-06	2.04E-06	2.04E-06	2.04E-06	5.68E-09	2.27E-06	2.02E-06	3.76E-07	2.66E-07	4.47E-06	2.18E-06	5.31E-09
Spinal Skel.	2.30E-06	2.30E-06	2.31E-06	2.30E-06	1.14E-08	2.54E-06	2.29E-06	4.24E-07	4.10E-07	4.99E-06	2.46E-06	6.98E-09
Thalami	1.15E-04	1.42E-04	2.33E-04	9.07E-05	1.44E-04	2.81E-03	5.71E-04	2.05E-05	1.34E-05	4.24E-04	6.79E-04	1.70E-05
Thyroid	1.75E-06	1.75E-06	1.75E-06	1.75E-06	4.40E-09	1.91E-06	1.73E-06	3.24E-07	1.63E-07	4.13E-06	1.87E-06	4.26E-09
Trunk	2.34E-08	2.35E-08	2.35E-08	2.35E-08	4.86E-11	2.64E-08	2.33E-08	4.41E-09	1.80E-09	7.83E-08	2.58E-08	5.58E-11
White Matter	3.08E-05	3.38E-05	4.42E-05	2.81E-05	1.63E-05	4.02E-04	8.42E-05	5.59E-06	3.63E-06	9.00E-05	9.95E-05	1.90E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.89E-06	1.50E-04	8.73E-06	4.67E-05	5.78E-06	8.24E-05	3.21E-05	1.08E-04	1.84E-05	1.04E-05	8.17E-06	1.74E-05
Caud. Nucl.	1.11E-05	6.05E-04	2.22E-05	1.46E-04	1.66E-05	2.05E-04	4.30E-05	2.84E-04	1.07E-05	9.34E-06	1.12E-05	2.19E-05
Cerebellum	8.82E-07	5.95E-06	1.22E-06	6.35E-06	3.71E-07	1.32E-05	2.45E-06	1.36E-05	4.21E-07	5.94E-07	7.64E-07	1.57E-06
Cereb. Cort.	1.57E-06	1.24E-05	2.48E-06	1.19E-05	1.17E-06	2.42E-05	4.51E-06	2.48E-05	9.14E-07	1.09E-06	1.39E-06	2.86E-06
Cranium	1.66E-06	8.00E-06	2.82E-06	8.72E-06	1.92E-06	1.69E-05	3.39E-06	1.73E-05	1.52E-06	1.84E-06	2.18E-06	2.35E-06
Eyes	9.97E-07	7.91E-06	1.26E-06	8.08E-06	1.40E-07	1.72E-05	3.15E-06	1.75E-05	3.15E-07	5.30E-07	7.19E-07	1.93E-06
Lent. Nucl.	1.68E-04	7.14E-03	3.09E-04	1.72E-03	2.28E-04	2.97E-03	1.72E-03	4.38E-03	1.18E-03	6.05E-04	4.14E-04	9.02E-04
Mandible	1.01E-06	4.98E-06	1.28E-06	5.30E-06	3.79E-07	1.10E-05	2.14E-06	1.13E-05	5.45E-07	8.72E-07	1.07E-06	1.47E-06
Other Tissues	5.26E-07	3.81E-06	7.00E-07	4.05E-06	1.51E-07	8.45E-06	1.55E-06	8.71E-06	2.09E-07	3.16E-07	4.17E-07	9.78E-07
Skin	3.86E-07	3.17E-06	5.06E-07	3.38E-06	7.30E-08	7.08E-06	1.26E-06	7.33E-06	1.29E-07	2.07E-07	2.81E-07	7.71E-07
Spinal Col.	2.81E-07	1.86E-06	3.55E-07	1.90E-06	3.81E-08	4.11E-06	7.99E-07	4.18E-06	9.17E-08	1.64E-07	2.18E-07	5.32E-07
Spinal Skel.	5.02E-07	2.11E-06	5.86E-07	2.16E-06	1.26E-07	4.52E-06	9.38E-07	4.56E-06	2.46E-07	4.26E-07	5.22E-07	6.73E-07
Thalami	9.83E-06	4.91E-04	1.97E-05	1.24E-04	1.48E-05	1.80E-04	3.76E-05	2.43E-04	9.43E-06	8.13E-06	9.76E-06	1.94E-05
Thyroid	1.77E-07	1.60E-06	2.21E-07	1.72E-06	1.36E-08	3.54E-06	6.14E-07	3.68E-06	4.89E-08	8.75E-08	1.21E-07	3.60E-07
Trunk	1.88E-09	2.19E-08	2.43E-09	2.85E-08	3.47E-11	5.39E-08	8.06E-09	6.06E-08	3.80E-10	6.98E-10	1.05E-09	4.38E-09
White Matter	3.49E-06	7.40E-05	6.21E-06	3.18E-05	3.86E-06	5.64E-05	1.10E-05	6.44E-05	2.59E-06	2.62E-06	3.26E-06	6.48E-06

Table B.65: S values for the 15-year-old Phantom for Sources Located in the Spinal CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.94E-06	2.94E-06	2.95E-06	2.94E-06	7.95E-09	4.77E-06	2.95E-06	5.44E-07	3.25E-07	6.91E-06	3.22E-06	7.46E-09
Caud. Nucl.	2.55E-06	2.55E-06	2.56E-06	2.55E-06	6.36E-09	2.82E-06	2.54E-06	4.71E-07	2.85E-07	5.70E-06	2.74E-06	6.36E-09
Cerebellum	4.75E-06	4.76E-06	4.77E-06	4.76E-06	1.27E-08	6.80E-06	4.76E-06	8.81E-07	5.34E-07	1.13E-05	5.17E-06	1.22E-08
Cereb. Cort.	2.76E-06	2.76E-06	2.77E-06	2.76E-06	7.63E-09	6.18E-06	2.80E-06	5.11E-07	3.02E-07	6.54E-06	3.10E-06	7.07E-09
Cranium	3.68E-06	3.89E-06	4.57E-06	3.51E-06	1.07E-06	2.50E-05	7.16E-06	6.75E-07	5.38E-07	9.79E-06	8.22E-06	1.28E-07
Eyes	1.42E-06	1.42E-06	1.42E-06	1.42E-06	2.38E-09	1.53E-06	1.41E-06	2.63E-07	1.38E-07	3.29E-06	1.52E-06	3.28E-09
Lent. Nucl.	3.52E-06	3.53E-06	3.53E-06	3.53E-06	9.34E-09	3.90E-06	3.50E-06	6.52E-07	4.17E-07	8.15E-06	3.78E-06	8.54E-09
Mandible	3.85E-06	3.86E-06	3.87E-06	3.86E-06	1.54E-08	4.30E-06	3.84E-06	7.14E-07	5.92E-07	8.92E-06	4.15E-06	1.10E-08
Other Tissues	1.03E-05	1.03E-05	1.03E-05	1.03E-05	3.08E-08	1.40E-05	1.03E-05	1.90E-06	1.14E-06	2.37E-05	1.11E-05	2.63E-08
Skin	3.32E-06	3.32E-06	3.33E-06	3.32E-06	9.14E-09	3.69E-06	3.30E-06	6.15E-07	3.43E-07	7.80E-06	3.57E-06	8.43E-09
Spinal Col.	5.70E-04	8.37E-04	1.72E-03	3.31E-04	1.41E-03	1.03E-02	4.37E-03	9.80E-05	6.80E-05	2.41E-03	4.91E-03	1.60E-04
Spinal Skel.	1.01E-04	1.23E-04	1.95E-04	8.23E-05	1.14E-04	2.23E-03	4.60E-04	1.80E-05	1.36E-05	3.60E-04	5.46E-04	1.28E-05
Thalami	3.83E-06	3.83E-06	3.84E-06	3.84E-06	9.25E-09	4.19E-06	3.80E-06	7.07E-07	4.20E-07	8.68E-06	4.10E-06	9.66E-09
Thyroid	9.82E-06	9.83E-06	9.86E-06	9.83E-06	3.59E-08	1.09E-05	9.77E-06	1.82E-06	1.20E-06	2.32E-05	1.06E-05	2.69E-08
Trunk	2.97E-07	3.00E-07	3.08E-07	2.96E-07	1.24E-08	6.54E-07	3.36E-07	5.52E-08	3.17E-08	7.66E-07	3.72E-07	2.00E-09
White Matter	2.64E-06	2.64E-06	2.65E-06	2.64E-06	7.06E-09	2.93E-06	2.62E-06	4.88E-07	2.93E-07	6.15E-06	2.83E-06	6.65E-09

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	3.55E-07	2.72E-06	4.53E-07	2.87E-06	6.08E-08	5.98E-06	1.09E-06	6.18E-06	1.17E-07	1.92E-07	2.59E-07	6.75E-07
Caud. Nucl.	3.16E-07	2.33E-06	3.84E-07	2.39E-06	2.83E-08	5.15E-06	9.40E-07	5.26E-06	9.23E-08	1.64E-07	2.23E-07	5.86E-07
Cerebellum	5.84E-07	4.40E-06	7.52E-07	4.69E-06	1.16E-07	9.67E-06	1.76E-06	1.00E-05	2.02E-07	3.26E-07	4.37E-07	1.10E-06
Cereb. Cort.	3.28E-07	2.60E-06	4.24E-07	2.70E-06	6.26E-08	5.62E-06	1.02E-06	5.82E-06	1.09E-07	1.76E-07	2.39E-07	6.31E-07
Cranium	6.05E-07	6.35E-06	8.57E-07	3.76E-06	3.82E-07	7.06E-06	1.39E-06	7.69E-06	3.87E-07	5.41E-07	6.56E-07	9.05E-07
Eyes	1.41E-07	1.29E-06	1.79E-07	1.38E-06	1.00E-09	2.95E-06	5.17E-07	3.07E-06	2.52E-08	4.69E-08	7.34E-08	3.11E-07
Lent. Nucl.	4.58E-07	3.22E-06	5.66E-07	3.39E-06	5.45E-08	7.21E-06	1.33E-06	7.44E-06	1.40E-07	2.42E-07	3.29E-07	8.44E-07
Mandible	7.07E-07	3.54E-06	8.09E-07	3.74E-06	1.08E-07	7.83E-06	1.52E-06	8.05E-06	2.95E-07	5.41E-07	6.75E-07	1.04E-06
Other Tissues	1.24E-06	9.47E-06	1.66E-06	9.98E-06	3.41E-07	2.08E-05	3.80E-06	2.15E-05	4.81E-07	7.32E-07	9.70E-07	2.37E-06
Skin	3.66E-07	3.05E-06	4.80E-07	3.27E-06	6.64E-08	6.86E-06	1.21E-06	7.15E-06	1.19E-07	1.93E-07	2.63E-07	7.39E-07
Spinal Col.	2.59E-05	3.64E-03	5.36E-05	6.42E-04	4.20E-05	6.50E-04	1.58E-04	1.23E-03	3.73E-05	2.81E-05	3.09E-05	5.97E-05
Spinal Skel.	1.21E-05	3.98E-04	2.81E-05	1.15E-04	2.67E-05	1.65E-04	3.48E-05	2.16E-04	1.61E-05	1.47E-05	1.69E-05	1.97E-05
Thalami	4.61E-07	3.50E-06	5.83E-07	3.63E-06	7.44E-08	7.71E-06	1.41E-06	7.90E-06	1.53E-07	2.57E-07	3.44E-07	8.70E-07
Thyroid	1.31E-06	9.05E-06	1.73E-06	9.84E-06	3.62E-07	2.05E-05	3.74E-06	2.14E-05	5.22E-07	7.99E-07	1.05E-06	2.40E-06
Trunk	3.42E-08	3.09E-07	4.46E-08	3.06E-07	7.11E-09	6.18E-07	1.09E-07	6.55E-07	1.16E-08	1.83E-08	2.47E-08	6.61E-08
White Matter	3.22E-07	2.42E-06	4.04E-07	2.57E-06	4.66E-08	5.37E-06	9.74E-07	5.55E-06	1.02E-07	1.72E-07	2.33E-07	6.07E-07

Table B.66: S values for the 15-year-old Phantom for Sources Located in the Spinal Skeleton.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	9.35E-09	5.90E-11	7.12E-09	6.64E-10	1.96E-08	3.47E-07	2.97E-08	1.06E-06	1.60E-07	5.84E-08	1.69E-07	1.83E-08
Caud. Nucl.	5.54E-09	4.42E-13	4.15E-09	9.01E-11	1.22E-08	3.15E-07	1.46E-08	9.32E-07	1.30E-07	5.01E-08	1.46E-07	1.69E-08
Cerebellum	1.53E-08	7.42E-11	1.16E-08	1.01E-09	3.35E-08	5.70E-07	5.82E-08	1.75E-06	2.71E-07	9.69E-08	2.79E-07	3.03E-08
Cereb. Cort.	8.57E-09	4.07E-11	6.52E-09	5.80E-10	1.92E-08	3.19E-07	2.94E-08	9.87E-07	1.47E-07	5.35E-08	1.57E-07	1.69E-08
Cranium	8.39E-07	4.88E-09	6.11E-07	5.08E-08	1.71E-06	5.83E-07	1.82E-07	1.34E-06	5.28E-07	3.11E-07	1.36E-06	2.74E-08
Eyes	4.19E-09	9.93E-13	3.10E-09	2.03E-10	7.55E-09	1.27E-07	5.25E-10	4.77E-07	4.06E-08	1.89E-08	7.18E-08	7.05E-09
Lent. Nucl.	1.14E-08	4.69E-11	8.68E-09	5.36E-10	2.23E-08	4.43E-07	2.85E-08	1.32E-06	2.07E-07	7.55E-08	2.09E-07	3.97E-02
Mandible	1.91E-08	1.88E-10	1.48E-08	1.57E-09	3.37E-08	7.11E-07	9.04E-08	1.51E-06	4.61E-07	1.42E-07	2.86E-07	3.26E-08
Other Tissues	2.71E-06	1.61E-08	1.98E-06	1.70E-07	5.51E-06	1.34E-06	3.36E-07	4.30E-06	1.01E-06	8.63E-07	4.26E-06	7.26E-08
Skin	1.06E-08	8.81E-11	8.03E-09	6.87E-10	2.15E-08	3.78E-07	6.10E-08	1.29E-06	1.84E-07	6.39E-08	1.97E-07	2.08E-08
Spinal Col.	3.07E-06	2.99E-09	1.45E-06	2.40E-08	2.61E-05	7.99E-06	3.53E-06	2.49E-05	5.19E-06	1.45E-06	1.36E-05	4.31E-07
Spinal Skel.	7.25E-04	8.55E-05	6.14E-04	2.15E-04	9.46E-04	3.02E-05	2.24E-05	2.42E-04	3.13E-04	3.78E-04	8.12E-04	4.52E-06
Thalami	1.12E-08	3.91E-11	8.42E-09	7.72E-10	2.31E-08	4.63E-07	3.88E-08	1.36E-06	2.22E-07	7.94E-08	2.16E-07	2.44E-08
Thyroid	4.39E-08	4.67E-10	3.42E-08	4 07E-09	7.35E-08	1.28E-06	2.73E-07	3.90E-06	7.44E-07	2.37E-07	6.33E-07	6.78E-08
Trunk	9.90E-09	5.71E-11	7.23E-09	5.90E-10	2.03E-08	3.20E-08	3.45E-09	1.03E-07	1.57E-08	7.44E-09	2.86E-08	1.70E-09
White Matter	8.67E-09	7.64E-11	6.61E-09	6.85E-10	1.67E-08	3.15E-07	2.35E-08	9.47E-07	1.43E-07	5.30E-08	1.52E-07	1.66E-08

Table B.67: S values for the 15-year-old Phantom for Sources Located in the Thalami.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.12E-05	8.38E-05	1.13E-04	5.49E-05	8.46E-05	4.65E-04	1.81E-04	1.95E-05	2.19E-05	1.32E-04	1.97E-04	3.09E-05
Caud. Nucl.	5.64E-05	6.00E-05	7.68E-05	5.39E-05	2.15E-05	1.31E-03	1.79E-04	1.02E-05	6.40E-06	1.93E-04	2.26E-04	1.04E-06
Cerebellum	1.01E-05	1.01E-05	1.01E-05	1.01E-05	3.45E-08	1.12E-05	1.00E-05	1.87E-06	1.22E-06	2.29E-05	1.08E-05	2.71E-08
Cereb. Cort.	1.19E-05	1.19E-05	1.20E-05	1.19E-05	4.15E-08	1.88E-05	1.20E-05	2.21E-06	1.43E-06	2.71E-05	1.30E-05	3.22E-08
Cranium	7.97E-06	7.99E-06	8.02E-06	7.98E-06	4.56E-08	8.96E-06	7.97E-06	1.48E-06	1.34E-06	1.82E-05	8.60E-06	2.52E-08
Eyes	5.60E-06	5.60E-06	5.62E-06	5.61E-06	1.48E-08	6.15E-06	5.57E-06	1.04E-06	6.28E-07	1.30E-05	6.02E-06	1.38E-08
Lent. Nucl.	1.45E-04	1.80E-04	2.95E-04	1.15E-04	1.83E-04	3.58E-03	7.25E-04	2.59E-05	1.70E-05	5.38E-04	8.63E-04	2.15E-05
Mandible	4.77E-06	4.77E-06	4.79E-06	4.78E-06	2.05E-08	5.31E-06	4.75E-06	8.82E-07	7.63E-07	1.09E-05	5.12E-06	1.36E-08
Other Tissues	4.40E-06	4.41E-06	4.42E-06	4.41E-06	1.27E-08	4.85E-06	4.38E-06	8.15E-07	5.08E-07	1.01E-05	4.72E-06	1.13E-08
Skin	3.33E-06	3.34E-06	3.35E-06	3.34E-06	8.43E-09	3.67E-06	3.31E-06	6.18E-07	3.48E-07	7.75E-06	3.58E-06	8.27E-09
Spinal Col.	3.14E-06	3.14E-06	3.15E-06	3.14E-06	9.54E-09	3.44E-06	3.12E-06	5.81E-07	4.00E-07	7.25E-06	3.35E-06	7.45E-09
Spinal Skel.	3.16E-06	3.17E-06	3.18E-06	3.17E-06	1.47E-08	3.54E-06	3.15E-06	5.84E-07	5.71E-07	7.02E-06	3.40E-06	9.22E-09
Thalami	3.36E-03	4.12E-03	5.76E-03	2.33E-03	5.22E-03	1.45E-02	8.80E-03	1.06E-03	1.33E-03	4.76E-03	9.26E-03	2.06E-03
Thyroid	1.67E-06	1.68E-06	1.68E-06	1.68E-06	6.14E-09	1.84E-06	1.66E-06	3.10E-07	1.65E-07	3.97E-06	1.80E-06	4.17E-09
Trunk	2.66E-08	2.66E-08	2.66E-08	2.66E-08	5.06E-11	2.98E-08	2.64E-08	5.00E-09	1.99E-09	8.81E-08	2.91E-08	6.35E-11
White Matter	3.11E-05	3.38E-05	4.30E-05	2.88E-05	1.44E-05	3.98E-04	7.96E-05	5.65E-06	3.65E-06	8.94E-05	9.44E-05	1.65E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.06E-06	1.51E-04	9.03E-06	4.79E-05	5.95E-06	8.49E-05	3.26E-05	1.10E-04	1.86E-05	1.05E-05	8.33E-06	1.77E-05
Caud. Nucl.	7.06E-06	1.61E-04	1.34E-05	6.25E-05	9.30E-06	1.10E-04	2.06E-05	1.23E-04	5.21E-06	5.29E-06	6.61E-06	1.28E-05
Cerebellum	1.35E-06	9.31E-06	1.98E-06	9.85E-06	7.43E-07	2.04E-05	3.82E-06	2.09E-05	7.16E-07	9.40E-07	1.20E-06	2.44E-06
Cereb. Cort.	1.58E-06	1.11E-05	2.46E-06	1.18E-05	1.11E-06	2.41E-05	4.50E-06	2.47E-05	9.13E-07	1.11E-06	1.41E-06	2.87E-06
Cranium	1.61E-06	7.51E-06	2.62E-06	8.24E-06	1.67E-06	1.61E-05	3.23E-06	1.65E-05	1.42E-06	1.79E-06	2.12E-06	2.26E-06
Eyes	6.84E-07	5.13E-06	8.40E-07	5.47E-06	5.66E-08	1.14E-05	2.08E-06	1.18E-05	1.90E-07	3.38E-07	4.66E-07	1.30E-06
Lent. Nucl.	1.25E-05	6.23E-04	2.50E-05	1.57E-04	1.87E-05	2.28E-04	4.76E-05	3.07E-04	1.19E-05	1.03E-05	1.24E-05	2.45E-05
Mandible	9.15E-07	4.40E-06	1.13E-06	4.64E-06	2.90E-07	9.62E-06	1.90E-06	9.84E-06	4.69E-07	7.76E-07	9.52E-07	1.31E-06
Other Tissues	5.59E-07	4.04E-06	7.42E-07	4.28E-06	1.61E-07	8.92E-06	1.64E-06	9.19E-06	2.25E-07	3.41E-07	4.48E-07	1.03E-06
Skin	3.74E-07	3.05E-06	4.87E-07	3.26E-06	6.73E-08	6.81E-06	1.22E-06	7.05E-06	1.24E-07	2.03E-07	2.74E-07	7.43E-07
Spinal Col.	4.42E-07	2.87E-06	5.66E-07	3.05E-06	9.86E-08	6.24E-06	1.21E-06	6.38E-06	1.58E-07	2.46E-07	3.30E-07	7.90E-07
Spinal Skel.	6.92E-07	2.92E-06	8.48E-07	3.05E-06	2.38E-07	6.39E-06	1.31E-06	6.50E-06	3.74E-07	6.15E-07	7.49E-07	9.40E-07
Thalami	1.65E-04	7.16E-03	3.05E-04	1.71E-03	2.25E-04	2.94E-03	1.69E-03	4.35E-03	1.15E-03	5.90E-04	4.05E-04	8.82E-04
Thyroid	1.81E-07	1.53E-06	2.27E-07	1.64E-06	2.12E-08	3.42E-06	5.96E-07	3.54E-06	5.76E-08	1.02E-07	1.37E-07	3.56E-07
Trunk	2.07E-09	2.48E-08	2.70E-09	3.22E-08	4.12E-11	6.07E-08	9.08E-09	6.81E-08	4.21E-10	7.77E-10	1.16E-09	4.91E-09
White Matter	3.59E-06	7.03E-05	6.40E-06	3.21E-05	3.97E-06	5.77E-05	1.12E-05	6.50E-05	2.64E-06	2.68E-06	3.35E-06	6.66E-06

Table B.68: S values for the 15-year-old Phantom for Sources Located in the Third Ventricle.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	7.20E-05	8.47E-05	1.14E-04	5.57E-05	8.46E-05	4.65E-04	1.82E-04	1.96E-05	2.20E-05	1.34E-04	1.98E-04	3.09E-05
Caud. Nucl.	4.52E-05	4.53E-05	4.54E-05	4.53E-05	1.81E-07	5.89E-05	4.52E-05	8.37E-06	5.28E-06	1.02E-04	4.89E-05	1.30E-07
Cerebellum	1.03E-05	1.03E-05	1.03E-05	1.03E-05	3.70E-08	1.14E-05	1.02E-05	1.90E-06	1.26E-06	2.34E-05	1.10E-05	2.79E-08
Cereb. Cort.	1.20E-05	1.20E-05	1.20E-05	1.20E-05	4.15E-08	1.37E-05	1.19E-05	2.22E-06	1.44E-06	2.71E-05	1.29E-05	3.24E-08
Cranium	7.72E-06	7.73E-06	7.76E-06	7.73E-06	4.31E-08	8.63E-06	7.71E-06	1.43E-06	1.31E-06	1.75E-05	8.32E-06	2.42E-08
Eyes	5.58E-06	5.59E-06	5.60E-06	5.59E-06	1.46E-08	6.13E-06	5.55E-06	1.03E-06	6.42E-07	1.28E-05	5.99E-06	1.36E-08
Lent. Nucl.	6.16E-05	6.17E-05	6.19E-05	6.17E-05	2.47E-07	4.63E-04	6.91E-05	1.14E-05	7.18E-06	1.48E-04	8.34E-05	1.73E-07
Mandible	4.27E-06	4.27E-06	4.29E-06	4.27E-06	1.71E-08	4.76E-06	4.25E-06	7.90E-07	6.85E-07	9.85E-06	4.59E-06	1.18E-08
Other Tissues	4.00E-06	4.01E-06	4.01E-06	4.01E-06	1.18E-08	4.41E-06	3.98E-06	7.41E-07	4.63E-07	9.20E-06	4.29E-06	1.03E-08
Skin	3.35E-06	3.36E-06	3.36E-06	3.36E-06	8.12E-09	3.70E-06	3.33E-06	6.21E-07	3.46E-07	7.76E-06	3.60E-06	8.54E-09
Spinal Col.	2.88E-06	2.89E-06	2.90E-06	2.89E-06	1.21E-08	3.21E-06	2.88E-06	5.34E-07	3.87E-07	6.79E-06	3.12E-06	7.73E-09
Spinal Skel.	3.04E-06	3.04E-06	3.05E-06	3.04E-06	1.40E-08	3.37E-06	3.03E-06	5.62E-07	5.44E-07	6.82E-06	3.26E-06	8.90E-09
Thalami	1.56E-04	1.61E-04	2.21E-04	1.54E-04	6.01E-05	7.94E-03	8.68E-04	2.87E-05	1.67E-05	7.69E-04	1.16E-03	7.41E-07
Thyroid	1.79E-06	1.79E-06	1.79E-06	1.79E-06	4.91E-09	1.96E-06	1.77E-06	3.29E-07	1.52E-07	4.13E-06	1.91E-06	4.64E-09
Trunk	2.50E-08	2.50E-08	2.50E-08	2.50E-08	4.94E-11	2.80E-08	2.49E-08	4.70E-09	1.88E-09	8.38E-08	2.74E-08	6.02E-11
White Matter	5.07E-05	6.40E-05	1.04E-04	3.85E-05	6.76E-05	5.87E-04	2.13E-04	9.03E-06	6.12E-06	1.57E-04	2.39E-04	8.45E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	5.18E-06	1.52E-04	9.22E-06	4.88E-05	6.06E-06	8.66E-05	3.29E-05	1.12E-04	1.87E-05	1.06E-05	8.45E-06	1.79E-05
Caud. Nucl.	5.87E-06	4.23E-05	1.07E-05	4.54E-05	6.90E-06	9.08E-05	1.71E-05	9.29E-05	4.29E-06	4.28E-06	5.42E-06	1.08E-05
Cerebellum	1.39E-06	9.50E-06	2.06E-06	1.01E-05	7.98E-07	2.08E-05	3.91E-06	2.14E-05	7.56E-07	9.82E-07	1.25E-06	2.51E-06
Cereb. Cort.	1.59E-06	1.11E-05	2.45E-06	1.18E-05	1.07E-06	2.42E-05	4.53E-06	2.47E-05	9.09E-07	1.12E-06	1.43E-06	2.89E-06
Cranium	1.57E-06	7.25E-06	2.47E-06	7.89E-06	1.48E-06	1.56E-05	3.13E-06	1.59E-05	1.33E-06	1.73E-06	2.05E-06	2.20E-06
Eyes	6.87E-07	5.11E-06	8.58E-07	5.38E-06	6.66E-08	1.13E-05	2.10E-06	1.17E-05	1.95E-07	3.45E-07	4.76E-07	1.33E-06
Lent. Nucl.	8.05E-06	6.61E-05	1.52E-05	6.28E-05	1.03E-05	1.25E-04	2.33E-05	1.29E-04	6.02E-06	5.84E-06	7.38E-06	1.47E-05
Mandible	8.21E-07	3.93E-06	9.86E-07	4.18E-06	2.19E-07	8.65E-06	1.70E-06	8.88E-06	3.99E-07	6.82E-07	8.39E-07	1.18E-06
Other Tissues	5.08E-07	3.67E-06	6.66E-07	3.89E-06	1.30E-07	8.12E-06	1.49E-06	8.37E-06	1.97E-07	3.06E-07	4.04E-07	9.41E-07
Skin	3.70E-07	3.07E-06	4.83E-07	3.26E-06	6.58E-08	6.85E-06	1.22E-06	7.09E-06	1.22E-07	2.01E-07	2.71E-07	7.43E-07
Spinal Col.	4.21E-07	2.66E-06	5.37E-07	2.84E-06	8.31E-08	5.91E-06	1.14E-06	6.11E-06	1.47E-07	2.38E-07	3.19E-07	7.58E-07
Spinal Skel.	6.59E-07	2.80E-06	7.97E-07	2.94E-06	2.06E-07	6.10E-06	1.25E-06	6.21E-06	3.45E-07	5.77E-07	7.04E-07	8.98E-07
Thalami	1.94E-05	7.82E-04	4.02E-05	1.91E-04	3.21E-05	3.13E-04	5.72E-05	3.59E-04	1.52E-05	1.49E-05	1.83E-05	3.55E-05
Thyroid	1.68E-07	1.63E-06	2.11E-07	1.68E-06	1.72E-08	3.54E-06	6.09E-07	3.61E-06	5.00E-08	8.70E-08	1.18E-07	3.45E-07
Trunk	1.96E-09	2.33E-08	2.55E-09	3.05E-08	3.84E-11	5.74E-08	8.55E-09	6.45E-08	3.99E-10	7.32E-10	1.10E-09	4.62E-09
White Matter	4.18E-06	1.80E-04	7.58E-06	5.20E-05	4.85E-06	7.64E-05	1.63E-05	1.05E-04	3.86E-06	3.47E-06	4.17E-06	8.23E-06

Table B.69: S values for the 15-year-old Phantom for Sources Located in the Thyroid.

Targets	S values (mGy MBq^{-1}s^{-1})											
	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{125m}I	^{126}I	^{130}I	^{131}I	^{132}I	^{132m}I	^{133}I
Brain (Total)	1.10E-07	9.65E-07	1.37E-07	1.07E-06	7.32E-09	4.33E-07	5.78E-09	2.20E-06	3.77E-07	2.32E-06	3.22E-07	6.22E-07
Caud. Nucl.	1.43E-07	1.16E-06	1.76E-07	1.28E-06	8.57E-09	5.16E-07	6.97E-09	2.59E-06	4.61E-07	2.72E-06	3.80E-07	7.40E-07
Cerebellum	1.05E-07	9.67E-07	1.30E-07	1.08E-06	4.05E-09	4.31E-07	3.47E-09	2.20E-06	3.73E-07	2.33E-06	3.20E-07	6.23E-07
Cereb. Cort.	1.00E-07	8.94E-07	1.26E-07	1.00E-06	6.92E-09	4.03E-07	5.41E-09	2.05E-06	3.48E-07	2.17E-06	3.00E-07	5.79E-07
Cranium	1.69E-07	9.37E-07	2.00E-07	1.04E-06	3.11E-08	4.34E-07	2.32E-08	2.14E-06	3.92E-07	2.25E-06	3.25E-07	6.03E-07
Eyes	1.01E-07	1.21E-06	1.29E-07	1.32E-06	9.46E-10	5.31E-07	1.13E-09	2.75E-06	4.42E-07	2.89E-06	3.97E-07	7.79E-07
Lent. Nucl.	1.96E-07	1.49E-06	2.41E-07	1.59E-06	1.47E-08	6.74E-07	1.17E-08	3.38E-06	6.05E-07	3.51E-06	4.99E-07	9.54E-07
Mandible	7.10E-07	3.51E-06	9.64E-07	3.74E-06	3.84E-07	1.66E-06	2.63E-07	7.66E-06	1.50E-06	7.85E-06	1.23E-06	2.19E-06
Other Tissues	1.57E-06	4.29E-05	2.80E-06	1.61E-05	1.72E-06	6.57E-06	9.50E-07	2.74E-05	5.33E-06	3.25E-05	4.89E-06	1.11E-05
Skin	3.66E-07	3.10E-06	6.01E-07	3.20E-06	2.88E-07	1 38E-06	1.66E-07	6.53E-06	1.18E-06	6.75E-06	1.02E-06	1.87E-06
Spinal Col.	1.26E-06	9.10E-06	1.66E-06	9.74E-06	3.44E-07	4.11E-06	2.38E-07	2.01E-05	3.69E-06	2.07E-05	3.02E-06	5.75E-06
Spinal Skel.	1.91E-06	9.56E-06	2.89E-06	1.04E-05	1.54E-06	4.64E-06	1.02E-06	2.08E-05	4.08E-06	2.13E-05	3.44E-06	5.95E-06
Thalami	1.65E-07	1.23E-06	2.02E-07	1.35E-06	1.37E-08	5.55E-07	1.07E-08	2.78E-06	4.98E-07	2.91E-06	4.10E-07	7.90E-07
Thyroid	2.56E-04	1.06E-02	4.70E-04	2.57E-03	3.46E-04	2.02E-03	8.88E-04	4.50E-03	2.65E-03	6.62E-03	2.09E-03	5.28E-03
Trunk	7.11E-08	5.94E-07	9.97E-08	5.92E-07	2.91E-08	2.46E-07	1.83E-08	1.20E-06	2.15E-07	1.26E-06	1.83E-07	3.44E-07
White Matter	1.15E-07	1.00E-06	1.44E-07	1.11E-06	8.03E-09	4.48E-07	6.33E-09	2.27E-06	3.91E-07	2.39E-06	3.32E-07	6.44E-07

Table B.70: S values for the 15-year-old Phantom for Sources Located in the White Matter.

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.82E-05	8.09E-05	1.10E-04	5.19E-05	8.46E-05	4.56E-04	1.78E-04	1.89E-05	2.15E-05	1.26E-04	1.94E-04	3.09E-05
Caud. Nucl.	3.72E-05	4.17E-05	5.66E-05	3.33E-05	2.37E-05	5.42E-04	1.14E-04	6.74E-06	4.34E-06	1.13E-04	1.35E-04	2.77E-06
Cerebellum	8.59E-06	8.60E-06	8.62E-06	8.60E-06	2.90E-08	1.53E-05	8.65E-06	1.59E-06	1.00E-06	1.96E-05	9.46E-06	2.30E-08
Cereb. Cort.	1.68E-05	1.81E-05	2.26E-05	1.56E-05	7.05E-06	1.96E-04	4.09E-05	3.05E-06	1.94E-06	4.78E-05	4.84E-05	8.08E-07
Cranium	8.86E-06	8.88E-06	8.91E-06	8.87E-06	5.11E-08	2.30E-05	9.11E-06	1.64E-06	1.38E-06	2.05E-05	1.01E-05	2.82E-08
Eyes	6.16E-06	6.17E-06	6.18E-06	6.17E-06	1.78E-08	6.84E-06	6.13E-06	1.14E-06	7.10E-07	1.46E-05	6.63E-06	1.58E-08
Lent. Nucl.	3.05E-05	3.36E-05	4.38E-05	2.79E-05	1.62E-05	3.96E-04	8.37E-05	5.54E-06	3.61E-06	8.98E-05	9.89E-05	1.90E-06
Mandible	3.13E-06	3.13E-06	3.14E-06	3.13E-06	1.20E-08	3.51E-06	3.12E-06	5.79E-07	4.66E-07	7.28E-06	3.37E-06	8.82E-09
Other Tissues	2.75E-06	2.75E-06	2.76E-06	2.75E-06	7.61E-09	3.08E-06	2.73E-06	5.09E-07	3.04E-07	6.40E-06	2.95E-06	7.01E-09
Skin	3.98E-06	3.98E-06	3.99E-06	3.98E-06	1.05E-08	4.44E-06	3.95E-06	7.36E-07	4.16E-07	9.16E-06	4.27E-06	1.03E-08
Spinal Col.	1.99E-06	2.00E-06	2.00E-06	2.00E-06	3.72E-09	2.20E-06	1.98E-06	3.69E-07	2.56E-07	4.72E-06	2.15E-06	4.46E-09
Spinal Skel.	1.92E-06	1.93E-06	1.93E-06	1.93E-06	8.31E-09	2.12E-06	1.92E-06	3.56E-07	3.27E-07	4.41E-06	2.07E-06	5.41E-09
Thalami	2.45E-05	2.66E-05	3.40E-05	2.26E-05	1.15E-05	3.09E-04	6.34E-05	4.44E-06	2.87E-06	7.02E-05	7.51E-05	1.30E-06
Thyroid	1.08E-06	1.08E-06	1.09E-06	1.09E-06	2.88E-09	1.19E-06	1.08E-06	2.01E-07	9.82E-08	2.59E-06	1.17E-06	2.53E-09
Trunk	1.61E-08	1.61E-08	1.62E-08	1.61E-08	2.81E-11	1.82E-08	1.60E-08	3.04E-09	1.16E-09	5.60E-08	1.77E-08	3.80E-11
White Matter	1.41E-04	1.70E-04	2.35E-04	1.03E-04	1.94E-04	8.37E-04	3.72E-04	4.14E-05	4.92E-05	2.36E-04	4.01E-04	7.33E-05

	S values (mGy $MBq^{-1}s^{-1}$)											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.64E-06	1.48E-04	8.32E-06	4.51E-05	5.56E-06	7.91E-05	3.15E-05	1.04E-04	1.83E-05	1.02E-05	7.93E-06	1.70E-05
Caud. Nucl.	4.03E-06	1.00E-04	7.32E-06	3.88E-05	4.71E-06	6.70E-05	1.31E-05	7.84E-05	3.10E-06	3.07E-06	3.80E-06	7.54E-06
Cerebellum	1.11E-06	8.05E-06	1.71E-06	8.46E-06	7.37E-07	1.73E-05	3.22E-06	1.78E-05	6.18E-07	7.59E-07	9.73E-07	2.03E-06
Cereb. Cort.	1.92E-06	3.62E-05	3.30E-06	1.73E-05	1.88E-06	3.15E-05	6.02E-06	3.52E-05	1.31E-06	1.38E-06	1.74E-06	3.60E-06
Cranium	1.65E-06	8.68E-06	3.05E-06	9.35E-06	2.31E-06	1.79E-05	3.54E-06	1.84E-05	1.65E-06	1.87E-06	2.20E-06	2.41E-06
Eyes	7.58E-07	5.66E-06	9.89E-07	6.12E-06	1.46E-07	1.27E-05	2.32E-06	1.32E-05	2.53E-07	4.07E-07	5.53E-07	1.47E-06
Lent. Nucl.	3.47E-06	7.36E-05	6.17E-06	3.17E-05	3.83E-06	5.61E-05	1.09E-05	6.42E-05	2.58E-06	2.63E-06	3.27E-06	6.44E-06
Mandible	5.54E-07	2.88E-06	6.70E-07	3.06E-06	1.42E-07	6.35E-06	1.22E-06	6.53E-06	2.57E-07	4.36E-07	5.42E-07	8.25E-07
Other Tissues	3.32E-07	2.52E-06	4.37E-07	2.69E-06	8.17E-08	5.60E-06	1.02E-06	5.79E-06	1.24E-07	1.92E-07	2.55E-07	6.31E-07
Skin	4.47E-07	3.65E-06	6.18E-07	3.89E-06	1.44E-07	8.14E-06	1.45E-06	8.42E-06	1.76E-07	2.52E-07	3.38E-07	8.87E-07
Spinal Col.	2.82E-07	1.83E-06	3.55E-07	1.98E-06	4.76E-08	4.21E-06	7.77E-07	4.40E-06	8.85E-08	1.41E-07	1.94E-07	5.06E-07
Spinal Skel.	3.91E-07	1.77E-06	4.73E-07	1.88E-06	1.11E-07	3.90E-06	7.83E-07	4.00E-06	1.92E-07	3.24E-07	3.99E-07	5.54E-07
Thalami	2.83E-06	5.59E-05	5.04E-06	2.52E-05	3.13E-06	4.51E-05	8.78E-06	5.08E-05	2.08E-06	2.13E-06	2.66E-06	5.25E-06
Thyroid	1.02E-07	9.96E-07	1.32E-07	1.07E-06	6.77E-09	2.23E-06	3.84E-07	2.33E-06	2.51E-08	4.54E-08	6.48E-08	2.26E-07
Trunk	1.20E-09	1.51E-08	1.57E-09	2.02E-08	1.76E-11	3.72E-08	5.46E-09	4.21E-08	2.29E-10	4.16E-10	6.39E-10	2.91E-09
White Matter	8.47E-06	3.07E-04	1.54E-05	8.44E-05	1.08E-05	1.46E-04	6.74E-05	2.02E-04	4.23E-05	2.26E-05	1.66E-05	3.58E-05

S Values in a Mathematical Model of the Head and Brain of an Adult

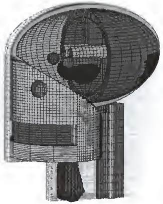


Table B.71: S values for the Adult Phantom for Sources Located in the Brain (total).

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	5.94E-05	7.04E-05	9.59E-05	4.51E-05	7.41E-05	3.70E-04	1.52E-04	1.66E-05	1.90E-05	1.07E-04	1.65E-04	2.74E-05
Caud. Nucl.	6.40E-05	7.53E-05	1.01E-04	4.94E-05	7.52E-05	4.14E-04	1.61E-04	1.75E-05	1.97E-05	1.19E-04	1.76E-04	2.77E-05
Cerebellum	5.76E-05	6.86E-05	9.36E-05	4.35E-05	7.34E-05	3.58E-04	1.49E-04	1.63E-05	1.88E-05	1.02E-04	1.61E-04	2.73E-05
Cereb. Cort.	5.69E-05	6.77E-05	9.23E-05	4.28E-05	7.27E-05	3.29E-04	1.45E-04	1.62E-05	1.87E-05	9.91E-05	1.56E-04	2.72E-05
Cranium	9.32E-06	9.60E-06	1.10E-05	9.17E-06	1.66E-06	9.23E-05	1.86E-05	1.70E-06	1.39E-06	2.61E-05	2.22E-05	5.61E-08
Eyes	4.78E-06	4.79E-06	4.80E-06	4.79E-06	1.28E-08	5.40E-06	4.76E-06	8.87E-07	5.36E-07	1.15E-05	5.16E-06	1.23E-08
Lent. Nucl.	6.29E-05	7.43E-05	1.01E-04	4.84E-05	7.54E-05	4.12E-04	1.61E-04	1.72E-05	1.94E-05	1.17E-04	1.76E-04	2.72E-05
Mandible	2.50E-06	2.50E-06	2.51E-06	2.50E-06	1.01E-08	3.23E-06	2.50E-06	4.62E-07	3.77E-07	5.86E-06	2.71E-06	6.69E-09
Other Tissues	2.46E-06	2.47E-06	2.47E-06	2.47E-06	6.72E-09	4.03E-06	2.47E-06	4.56E-07	2.69E-07	5.80E-06	2.70E-06	6.22E-09
Skin	3.83E-06	3.83E-06	3.84E-06	3.83E-06	9.59E-09	1.30E-05	3.97E-06	7.09E-07	3.91E-07	9.03E-06	4.49E-06	9.68E-09
Spinal Col.	2.11E-06	2.12E-06	2.12E-06	2.12E-06	4.62E-09	3.94E-06	2.13E-06	3.93E-07	2.37E-07	5.13E-06	2.33E-06	4.97E-09
Spinal Skel.	2.13E-06	2.13E-06	2.14E-06	2.13E-06	9.30E-09	2.97E-06	2.13E-06	3.94E-07	3.36E-07	4.89E-06	2.32E-06	5.92E-09
Thalami	6.43E-05	7.55E-05	1.02E-04	4.99E-05	7.52E-05	4.14E-04	1.62E-04	1.76E-05	1.97E-05	1.20E-04	1.77E-04	2.75E-05
Thyroid	9.63E-07	9.64E-07	9.66E-07	9.65E-07	1.68E-09	1.05E-06	9.57E-07	1.79E-07	8.09E-08	2.36E-06	1.04E-06	2.21E-09
Trunk	1.63E-08	1.63E-08	1.63E-08	1.63E-08	3.23E-11	1.84E-08	1.62E-08	3.07E-09	1.17E-09	5.70E-08	1.79E-08	3.83E-11
White Matter	6.16E-05	7.29E-05	9.93E-05	4.71E-05	7.55E-05	4.09E-04	1.59E-04	1.70E-05	1.93E-05	1.14E-04	1.74E-04	2.76E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	3.98E-06	1.27E-04	7.09E-06	3.86E-05	4.69E-06	6.80E-05	2.76E-05	8.98E-05	1.62E-05	8.96E-06	6.91E-06	1.48E-05
Caud. Nucl.	4.62E-06	1.35E-04	8.24E-06	4.31E-05	5.41E-06	7.68E-05	2.94E-05	9.93E-05	1.67E-05	9.46E-06	7.53E-06	1.60E-05
Cerebellum	3.77E-06	1.23E-04	6.73E-06	3.68E-05	4.47E-06	6.48E-05	2.70E-05	8.63E-05	1.60E-05	8.80E-06	6.71E-06	1.45E-05
Cereb. Cort.	3.68E-06	1.20E-04	6.54E-06	3.60E-05	4.32E-06	6.35E-05	2.67E-05	8.46E-05	1.59E-05	8.72E-06	6.62E-06	1.43E-05
Cranium	1.65E-06	1.69E-05	3.22E-06	1.04E-05	2.59E-06	1.87E-05	3.64E-06	2.00E-05	1.71E-06	1.87E-06	2.20E-06	2.46E-06
Eyes	5.72E-07	4.40E-06	7.37E-07	4.76E-06	8.91E-08	1.00E-05	1.79E-06	1.05E-05	1.80E-07	3.01E-07	4.11E-07	1.12E-06
Lent. Nucl.	4.47E-06	1.34E-04	7.93E-06	4.25E-05	5.18E-06	7.47E-05	2.88E-05	9.71E-05	1.64E-05	9.33E-06	7.38E-06	1.57E-05
Mandible	4.49E-07	2.31E-06	5.36E-07	2.46E-06	1.04E-07	5.09E-06	9.80E-07	5.25E-06	2.01E-07	3.43E-07	4.29E-07	6.65E-07
Other Tissues	2.92E-07	2.29E-06	3.86E-07	2.42E-06	6.99E-08	5.03E-06	9.07E-07	5.21E-06	1.06E-07	1.65E-07	2.21E-07	5.62E-07
Skin	4.16E-07	3.70E-06	5.84E-07	3.75E-06	1.40E-07	7.81E-06	1.39E-06	8.08E-06	1.65E-07	2.34E-07	3.14E-07	8.46E-07
Spinal Col.	2.57E-07	1.97E-06	3.33E-07	2.13E-06	5.12E-08	4.26E-06	7.84E-07	4.42E-06	8.79E-08	1.41E-07	1.90E-07	4.92E-07
Spinal Skel.	4.04E-07	1.97E-06	4.88E-07	2.08E-06	1.13E-07	4.31E-06	8.42E-07	4.43E-06	1.96E-07	3.28E-07	4.05E-07	5.78E-07
Thalami	4.70E-06	1.36E-04	8.31E-06	4.36E-05	5.45E-06	7.74E-05	2.95E-05	9.97E-05	1.67E-05	9.53E-06	7.64E-06	1.61E-05
Thyroid	8.93E-08	8.83E-07	1.11E-07	9.67E-07	5.25E-09	2.00E-06	3.29E-07	2.11E-06	2.43E-08	4.43E-08	6.10E-08	1.85E-07
Trunk	1.20E-09	1.52E-08	1.59E-09	2.04E-08	1.36E-11	3.80E-08	5.55E-09	4.32E-08	2.19E-10	4.01E-10	6.26E-10	2.96E-09
White Matter	4.24E-06	1.33E-04	7.58E-06	4.09E-05	5.02E-06	7.21E-05	2.84E-05	9.45E-05	1.64E-05	9.18E-06	7.18E-06	1.53E-05

Table B.72: S values for the Adult Phantom for Sources Located in the Caudate Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.41E-05	7.54E-05	1.02E-04	4.96E-05	7.55E-05	4.15E-04	1.62E-04	1.75E-05	1.96E-05	1.19E-04	1.77E-04	2.75E-05
Caud. Nucl.	5.79E-03	7.08E-03	9.76E-03	4.02E-03	8.98E-03	1.80E-02	1.41E-02	1.87E-03	2.37E-03	7.43E-03	1.47E-02	3.67E-03
Cerebellum	5.28E-06	5.28E-06	5.30E-06	5.29E-06	1.68E-08	5.84E-06	5.25E-06	9.77E-07	6.44E-07	1.21E-05	5.66E-06	1.42E-08
Cereb. Cort.	1.08E-05	1.08E-05	1.08E-05	1.08E-05	3.67E-08	1.26E-05	1.07E-05	1.99E-06	1.29E-06	2.44E-05	1.16E-05	2.86E-08
Cranium	7.19E-06	7.20E-06	7.22E-06	7.20E-06	3.85E-08	8.05E-06	7.18E-06	1.33E-06	1.19E-06	1.63E-05	7.74E-06	2.22E-08
Eyes	7.04E-06	7.05E-06	7.07E-06	7.06E-06	1.91E-08	7.69E-06	7.00E-06	1.30E-06	8.08E-07	1.64E-05	7.58E-06	1.81E-08
Lent. Nucl.	1.30E-04	1.62E-04	2.71E-04	1.00E-04	1.74E-04	3.27E-03	6.77E-04	2.31E-05	1.53E-05	4.90E-04	8.04E-04	2.01E-05
Mandible	3.29E-06	3.29E-06	3.30E-06	3.29E-06	1.29E-08	3.65E-06	3.28E-06	6.09E-07	5.09E-07	7.58E-06	3.53E-06	9.12E-09
Other Tissues	2.48E-06	2.49E-06	2.49E-06	2.49E-06	6.79E-09	2.74E-06	2.47E-06	4.60E-07	2.82E-07	5.79E-06	2.67E-06	6.33E-09
Skin	3.18E-06	3.18E-06	3.19E-06	3.19E-06	7.61E-09	3.51E-06	3.16E-06	5.89E-07	3.25E-07	7.37E-06	3.42E-06	7.81E-09
Spinal Col.	1.47E-06	1.47E-06	1.48E-06	1.48E-06	3.69E-09	1.62E-06	1.47E-06	2.72E-07	1.93E-07	3.21E-06	1.58E-06	3.56E-09
Spinal Skel.	1.53E-06	1.54E-06	1.54E-06	1.54E-06	7.06E-09	1.70E-06	1.53E-06	2.84E-07	2.81E-07	3.44E-06	1.65E-06	4.41E-09
Thalami	5.37E-05	5.64E-05	6.98E-05	5.20E-05	1.64E-05	1.19E-03	1.58E-04	9.72E-06	6.04E-06	1.78E-04	2.00E-04	6.30E-07
Thyroid	1.13E-06	1.13E-06	1.13E-06	1.13E-06	2.12E-09	1.24E-06	1.12E-06	2.09E-07	1.16E-07	2.74E-06	1.21E-06	2.80E-09
Trunk	1.87E-08	1.87E-08	1.87E-08	1.87E-08	3.70E-11	2.11E-08	1.86E-08	3.52E-09	1.34E-09	6.49E-08	2.05E-08	4.49E-11
White Matter	3.32E-05	3.70E-05	4.97E-05	2.99E-05	2.00E-05	4.70E-04	9.87E-05	6.04E-06	3.92E-06	1.00E-04	1.17E-04	2.29E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.60E-06	1.35E-04	8.18E-06	4.34E-05	5.37E-06	7.70E-05	2.93E-05	9.96E-05	1.66E-05	9.44E-06	7.50E-06	1.59E-05
Caud. Nucl.	2.79E-04	1.14E-02	5.09E-04	2.79E-03	3.72E-04	4.91E-03	2.97E-03	7.27E-03	2.06E-03	1.05E-03	7.11E-04	1.55E-03
Cerebellum	7.16E-07	4.85E-06	9.78E-07	5.16E-06	2.74E-07	1.07E-05	1.99E-06	1.10E-05	3.29E-07	4.73E-07	6.11E-07	1.28E-06
Cereb. Cort.	1.43E-06	9.97E-06	2.18E-06	1.06E-05	9.35E-07	2.17E-05	4.07E-06	2.23E-05	8.02E-07	9.88E-07	1.26E-06	2.59E-06
Cranium	1.42E-06	6.74E-06	2.24E-06	7.33E-06	1.33E-06	1.45E-05	2.89E-06	1.48E-05	1.19E-06	1.54E-06	1.83E-06	2.02E-06
Eyes	8.70E-07	6.46E-06	1.10E-06	6.89E-06	1.24E-07	1.46E-05	2.65E-06	1.51E-05	2.70E-07	4.52E-07	6.17E-07	1.67E-06
Lent. Nucl.	1.09E-05	5.81E-04	2.17E-05	1.41E-04	1.62E-05	2.00E-04	4.20E-05	2.76E-04	1.05E-05	9.11E-06	1.09E-05	2.14E-05
Mandible	6.10E-07	3.02E-06	7.21E-07	3.20E-06	1.37E-07	6.67E-06	1.30E-06	6.85E-06	2.75E-07	4.75E-07	5.90E-07	8.85E-07
Other Tissues	3.09E-07	2.28E-06	3.93E-07	2.43E-06	5.47E-08	5.07E-06	9.23E-07	5.25E-06	1.05E-07	1.74E-07	2.32E-07	5.78E-07
Skin	3.51E-07	2.91E-06	4.61E-07	3.10E-06	7.18E-08	6.49E-06	1.15E-06	6.72E-06	1.21E-07	1.91E-07	2.58E-07	6.98E-07
Spinal Col.	2.08E-07	1.35E-06	2.59E-07	1.36E-06	2.66E-08	2.94E-06	5.76E-07	2.97E-06	6.19E-08	1.05E-07	1.44E-07	3.83E-07
Spinal Skel.	3.43E-07	1.41E-06	3.84E-07	1.46E-06	5.29E-08	3.09E-06	6.37E-07	3.14E-06	1.43E-07	2.58E-07	3.23E-07	4.60E-07
Thalami	6.74E-06	1.42E-04	1.27E-05	5.88E-05	8.77E-06	1.05E-04	1.96E-05	1.16E-04	4.94E-06	5.03E-06	6.28E-06	1.23E-05
Thyroid	1.24E-07	1.03E-06	1.55E-07	1.11E-06	8.71E-09	2.33E-06	4.11E-07	2.44E-06	3.26E-08	5.86E-08	8.21E-08	2.50E-07
Trunk	1.38E-09	1.75E-08	1.81E-09	2.33E-08	1.56E-11	4.33E-08	6.34E-09	4.90E-08	2.63E-10	4.85E-10	7.43E-10	3.37E-09
White Matter	3.70E-06	8.64E-05	6.65E-06	3.47E-05	4.21E-06	6.03E-05	1.18E-05	7.00E-05	2.80E-06	2.80E-06	3.48E-06	6.88E-06

Table B.73: S values for the Adult Phantom for Sources Located in the Cerebellum.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	5.76E-05	6.86E-05	9.38E-05	4.34E-05	7.36E-05	3.56E-04	1.49E-04	1.63E-05	1.88E-05	1.02E-04	1.61E-04	2.73E-05
Caud. Nucl.	5.30E-06	5.30E-06	5.32E-06	5.31E-06	1.58E-08	5.78E-06	5.27E-06	9.79E-07	6.45E-07	1.21E-05	5.67E-06	1.38E-08
Cerebellum	5.13E-04	6.25E-04	8.76E-04	3.66E-04	7.55E-04	3.09E-03	1.40E-03	1.54E-04	1.87E-04	8.32E-04	1.51E-03	2.86E-04
Cereb. Cort.	1.24E-05	1.33E-05	1.63E-05	1.16E-05	4.80E-06	1.34E-04	2.87E-05	2.27E-06	1.43E-06	3.47E-05	3.39E-05	5.57E-07
Cranium	1.00E-05	1.04E-05	1.22E-05	9.83E-06	2.13E-06	1.20E-04	2.22E-05	1.82E-06	1.47E-06	2.93E-05	2.69E-05	6.15E-08
Eyes	1.25E-06	1.25E-06	1.26E-06	1.25E-06	2.99E-09	1.41E-06	1.24E-06	2.33E-07	1.23E-07	3.21E-06	1.35E-06	3.04E-09
Lent. Nucl.	5.54E-06	5.55E-06	5.57E-06	5.55E-06	1.83E-08	6.15E-06	5.52E-06	1.03E-06	6.87E-07	1.27E-05	5.95E-06	1.41E-08
Mandible	1.50E-06	1.50E-06	1.51E-06	1.50E-06	5.13E-09	1.66E-06	1.49E-06	2.78E-07	2.18E-07	3.63E-06	1.62E-06	4.13E-09
Other Tissues	2.98E-06	2.98E-06	2.99E-06	2.99E-06	8.34E-09	6.29E-06	3.02E-06	5.52E-07	3.25E-07	7.04E-06	3.33E-06	7.62E-09
Skin	3.86E-06	3.87E-06	3.87E-06	3.87E-06	1.02E-08	1.21E-05	3.99E-06	7.15E-07	3.96E-07	9.07E-06	4.49E-06	9.84E-09
Spinal Col.	3.80E-06	3.80E-06	3.81E-06	3.81E-06	5.24E-09	4.23E-06	3.77E-06	7.04E-07	3.97E-07	8.86E-06	4.08E-06	8.60E-09
Spinal Skel.	3.73E-06	3.73E-06	3.75E-06	3.74E-06	1.53E-08	4.67E-06	3.73E-06	6.91E-07	5.66E-07	8.79E-06	4.04E-06	1.07E-08
Thalami	8.82E-06	8.83E-06	8.85E-06	8.83E-06	2.56E-08	9.80E-06	8.77E-06	1.63E-06	1.08E-06	1.98E-05	9.45E-06	2.39E-08
Thyroid	8.31E-07	8.32E-07	8.33E-07	8.33E-07	1.49E-09	9.13E-07	8.25E-07	1.55E-07	7.99E-08	2.26E-06	9.01E-07	2.25E-09
Trunk	1.71E-08	1.71E-08	1.72E-08	1.72E-08	3.27E-11	1.93E-08	1.70E-08	3.23E-09	1.21E-09	5.86E-08	1.88E-08	4.09E-11
White Matter	7.91E-06	7.92E-06	7.94E-06	7.92E-06	2.67E-08	1.36E-05	7.96E-06	1.46E-06	9.35E-07	1.81E-05	8.70E-06	2.11E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	3.77E-06	1.24E-04	6.72E-06	3.68E-05	4.48E-06	6.47E-05	2.69E-05	8.62E-05	1.60E-05	8.80E-06	6.71E-06	1.45E-05
Caud. Nucl.	7.02E-07	4.87E-06	9.75E-07	5.11E-06	2.73E-07	1.06E-05	2.01E-06	1.08E-05	3.20E-07	4.63E-07	6.00E-07	1.30E-06
Cerebellum	2.81E-05	1.15E-03	5.22E-05	2.92E-04	3.80E-05	4.97E-04	2.49E-04	7.10E-04	1.62E-04	8.48E-05	6.05E-05	1.31E-04
Cereb. Cort.	1.43E-06	2.55E-05	2.41E-06	1.27E-05	1.33E-06	2.34E-05	4.46E-06	2.60E-05	9.45E-07	1.01E-06	1.28E-06	2.67E-06
Cranium	1.75E-06	2.02E-05	3.56E-06	1.14E-05	3.01E-06	2.01E-05	3.90E-06	2.16E-05	1.90E-06	2.01E-06	2.35E-06	2.62E-06
Eyes	1.32E-07	1.15E-06	1.63E-07	1.29E-06	3.85E-09	2.67E-06	4.51E-07	2.83E-06	3.00E-08	5.49E-08	7.95E-08	2.68E-07
Lent. Nucl.	7.68E-07	5.10E-06	1.03E-06	5.41E-06	2.75E-07	1.12E-05	2.10E-06	1.15E-05	3.44E-07	5.02E-07	6.49E-07	1.35E-06
Mandible	2.61E-07	1.38E-06	2.92E-07	1.49E-06	2.34E-08	3.08E-06	5.82E-07	3.20E-06	9.43E-08	1.78E-07	2.26E-07	3.89E-07
Other Tissues	3.53E-07	2.80E-06	4.76E-07	2.94E-06	1.02E-07	6.10E-06	1.10E-06	6.32E-06	1.37E-07	2.04E-07	2.72E-07	6.79E-07
Skin	4.23E-07	3.71E-06	6.00E-07	3.79E-06	1.57E-07	7.90E-06	1.41E-06	8.18E-06	1.74E-07	2.39E-07	3.21E-07	8.55E-07
Spinal Col.	4.30E-07	3.48E-06	5.48E-07	3.73E-06	6.04E-08	7.80E-06	1.38E-06	8.11E-06	1.33E-07	2.25E-07	3.06E-07	8.46E-07
Spinal Skel.	6.71E-07	3.45E-06	8.25E-07	3.71E-06	1.98E-07	7.64E-06	1.47E-06	7.91E-06	3.33E-07	5.58E-07	6.88E-07	9.97E-07
Thalami	1.18E-06	8.12E-06	1.70E-06	8.59E-06	5.81E-07	1.77E-05	3.35E-06	1.81E-05	6.00E-07	8.18E-07	1.05E-06	2.16E-06
Thyroid	8.43E-08	7.66E-07	1.05E-07	8.91E-07	1.18E-09	1.81E-06	3.00E-07	1.95E-06	1.81E-08	3.45E-08	5.03E-08	1.78E-07
Trunk	1.24E-09	1.60E-08	1.65E-09	2.12E-08	1.12E-11	3.95E-08	5.81E-09	4.46E-08	2.24E-10	4.08E-10	6.41E-10	3.08E-09
White Matter	1.04E-06	7.41E-06	1.57E-06	7.80E-06	6.62E-07	1.60E-05	2.97E-06	1.64E-05	5.70E-07	7.12E-07	9.12E-07	1.88E-06

Table B.74: S values for the Adult Phantom for Sources Located in the Cerebral Cortex.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	5.68E-05	6.76E-05	9.21E-05	4.28E-05	7.26E-05	3.29E-04	1.45E-04	1.62E-05	1.87E-05	9.90E-05	1.56E-04	2.72E-05
Caud. Nucl.	1.09E-05	1.09E-05	1.10E-05	1.09E-05	3.39E-08	1.25E-05	1.09E-05	2.02E-06	1.32E-06	2.43E-05	1.17E-05	2.97E-08
Cerebellum	1.23E-05	1.32E-05	1.63E-05	1.15E-05	4.82E-06	1.34E-04	2.86E-05	2.25E-06	1.42E-06	3.48E-05	3.37E-05	5.53E-07
Cereb. Cort.	1.14E-04	1.38E-04	1.91E-04	8.23E-05	1.64E-04	5.67E-04	2.96E-04	3.45E-05	4.18E-05	1.78E-04	3.15E-04	6.33E-05
Cranium	1.07E-05	1.13E-05	1.41E-05	1.04E-05	3.38E-06	1.72E-04	2.96E-05	1.93E-06	1.51E-06	3.42E-05	3.63E-05	9.05E-08
Eyes	4.94E-06	4.94E-06	4.95E-06	4.95E-06	1.39E-08	5.68E-06	4.91E-06	9.13E-07	5.24E-07	1.15E-05	5.30E-06	1.21E-08
Lent. Nucl.	1.09E-05	1.09E-05	1.09E-05	1.09E-05	4.41E-08	3.50E-05	1.14E-05	2.01E-06	1.30E-06	2.48E-05	1.29E-05	2.96E-08
Mandible	2.43E-06	2.43E-06	2.44E-06	2.43E-06	8.91E-09	3.82E-06	2.44E-06	4.50E-07	3.55E-07	5.73E-06	2.66E-06	6.72E-09
Other Tissues	2.28E-06	2.29E-06	2.29E-06	2.29E-06	6.40E-09	4.96E-06	2.32E-06	4.23E-07	2.49E-07	5.45E-06	2.56E-06	5.80E-09
Skin	4.16E-06	4.16E-06	4.17E-06	4.17E-06	1.09E-08	2.38E-05	4.51E-06	7.71E-07	4.22E-07	9.98E-06	5.30E-06	1.05E-08
Spinal Col.	2.27E-06	2.27E-06	2.27E-06	2.27E-06	6.92E-09	4.41E-06	2.28E-06	4.19E-07	2.35E-07	5.17E-06	2.49E-06	5.87E-09
Spinal Skel.	2.01E-06	2.01E-06	2.02E-06	2.01E-06	8.85E-09	3.75E-06	2.03E-06	3.72E-07	3.13E-07	4.69E-06	2.23E-06	5.79E-09
Thalami	1.06E-05	1.06E-05	1.07E-05	1.06E-05	3.72E-08	1.42E-05	1.06E-05	1.96E-06	1.30E-06	2.41E-05	1.15E-05	2.84E-08
Thyroid	8.20E-07	8.21E-07	8.22E-07	8.22E-07	1.41E-09	8.79E-07	8.14E-07	1.53E-07	8.65E-08	2.22E-06	8.86E-07	2.04E-09
Trunk	1.48E-08	1.48E-08	1.48E-08	1.48E-08	2.65E-11	1.68E-08	1.47E-08	2.79E-09	1.06E-09	5.19E-08	1.63E-08	3.58E-11
White Matter	1.53E-05	1.64E-05	2.03E-05	1.43E-05	6.04E-06	1.71E-04	3.62E-05	2.80E-06	1.78E-06	4.31E-05	4.27E-05	6.93E-07

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	3.68E-06	1.20E-04	6.55E-06	3.59E-05	4.32E-06	6.33E-05	2.67E-05	8.44E-05	1.59E-05	8.73E-06	6.63E-06	1.43E-05
Caud. Nucl.	1.44E-06	1.01E-05	2.22E-06	1.06E-05	9.41E-07	2.19E-05	4.15E-06	2.23E-05	8.01E-07	9.90E-07	1.27E-06	2.66E-06
Cerebellum	1.41E-06	2.53E-05	2.40E-06	1.27E-05	1.34E-06	2.33E-05	4.43E-06	2.60E-05	9.45E-07	1.01E-06	1.28E-06	2.65E-06
Cereb. Cort.	6.38E-06	2.43E-04	1.15E-05	6.45E-05	8.04E-06	1.12E-04	5.57E-05	1.58E-04	3.60E-05	1.89E-05	1.35E-05	2.94E-05
Cranium	1.80E-06	2.67E-05	3.78E-06	1.24E-05	3.29E-06	2.12E-05	4.09E-06	2.35E-05	1.99E-06	2.07E-06	2.42E-06	2.72E-06
Eyes	5.59E-07	4.52E-06	7.27E-07	4.78E-06	9.31E-08	9.91E-06	1.81E-06	1.02E-05	1.76E-07	2.87E-07	3.93E-07	1.12E-06
Lent. Nucl.	1.44E-06	1.07E-05	2.22E-06	1.06E-05	9.90E-07	2.18E-05	4.10E-06	2.23E-05	8.14E-07	9.98E-07	1.28E-06	2.61E-06
Mandible	4.22E-07	2.26E-06	5.13E-07	2.40E-06	1.11E-07	4.95E-06	9.43E-07	5.11E-06	1.95E-07	3.26E-07	4.06E-07	6.32E-07
Other Tissues	2.71E-07	2.15E-06	3.59E-07	2.26E-06	6.85E-08	4.69E-06	8.41E-07	4.87E-06	1.00E-07	1.54E-07	2.05E-07	5.20E-07
Skin	4.50E-07	4.23E-06	6.43E-07	4.08E-06	1.71E-07	8.53E-06	1.51E-06	8.84E-06	1.85E-07	2.52E-07	3.39E-07	9.15E-07
Spinal Col.	2.49E-07	2.11E-06	3.30E-07	2.15E-06	4.87E-08	4.43E-06	8.24E-07	4.50E-06	8.11E-08	1.29E-07	1.76E-07	5.08E-07
Spinal Skel.	3.71E-07	1.89E-06	4.63E-07	1.98E-06	1.22E-07	4.11E-06	7.97E-07	4.24E-06	1.88E-07	3.06E-07	3.78E-07	5.46E-07
Thalami	1.44E-06	9.86E-06	2.19E-06	1.04E-05	9.40E-07	2.14E-05	4.03E-06	2.20E-05	8.12E-07	1.01E-06	1.29E-06	2.58E-06
Thyroid	9.08E-08	7.55E-07	1.14E-07	8.76E-07	4.78E-09	1.76E-06	3.04E-07	1.88E-06	2.17E-08	3.96E-08	5.68E-08	1.87E-07
Trunk	1.09E-09	1.39E-08	1.44E-09	1.86E-08	1.38E-11	3.44E-08	5.04E-09	3.90E-08	1.99E-10	3.63E-10	5.67E-10	2.69E-09
White Matter	1.77E-06	3.20E-05	3.02E-06	1.57E-05	1.69E-06	2.88E-05	5.52E-06	3.21E-05	1.19E-06	1.28E-06	1.61E-06	3.32E-06

Table B.75: S values for the Adult Phantom for Sources Located in the Cranial CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	1.89E-05	2.31E-05	3.44E-05	1.44E-05	2.16E-05	1.78E-04	6.22E-05	3.50E-06	2.36E-06	5.01E-05	6.93E-05	3.66E-06
Caud. Nucl.	7.91E-06	7.92E-06	7.94E-06	7.92E-06	2.71E-08	8.76E-06	7.86E-06	1.46E-06	9.49E-07	1.81E-05	8.49E-06	2.12E-08
Cerebellum	2.26E-05	2.85E-05	4.41E-05	1.66E-05	2.98E-05	2.35E-04	8.23E-05	4.19E-06	2.85E-06	6.15E-05	9.16E-05	4.92E-06
Cereb. Cort.	2.90E-05	3.77E-05	6.07E-05	1.98E-05	4.43E-05	3.21E-04	1.17E-04	5.39E-06	3.73E-06	7.98E-05	1.30E-04	7.49E-06
Cranium	3.77E-05	5.07E-05	8.55E-05	2.41E-05	6.62E-05	4.07E-04	1.70E-04	6.99E-06	5.31E-06	1.06E-04	1.88E-04	1.10E-05
Eyes	4.84E-06	4.85E-06	4.86E-06	4.85E-06	1.66E-08	6.93E-06	4.85E-06	8.99E-07	5.13E-07	1.16E-05	5.28E-06	1.25E-08
Lent. Nucl.	8.59E-06	8.60E-06	8.63E-06	8.61E-06	3.29E-08	1.38E-05	8.63E-06	1.59E-06	1.02E-06	1.93E-05	9.39E-06	2.31E-08
Mandible	2.55E-06	2.56E-06	2.57E-06	2.56E-06	1.11E-08	6.76E-06	2.66E-06	4.73E-07	3.72E-07	6.17E-06	2.97E-06	7.06E-09
Other Tissues	2.64E-06	2.64E-06	2.65E-06	2.65E-06	8.04E-09	1.40E-05	2.88E-06	4.89E-07	2.83E-07	6.46E-06	3.37E-06	6.77E-09
Skin	4.84E-06	4.85E-06	4.86E-06	4.85E-06	1.46E-08	7.17E-05	6.27E-06	8.97E-07	4.83E-07	1.26E-05	8.28E-06	1.22E-08
Spinal Col.	2.40E-06	2.40E-06	2.40E-06	2.40E-06	7.79E-09	1.20E-05	2.57E-06	4.45E-07	2.53E-07	5.77E-06	2.99E-06	5.97E-09
Spinal Skel.	2.36E-06	2.36E-06	2.37E-06	2.36E-06	9.71E-09	9.09E-06	2.48E-06	4.36E-07	3.55E-07	5.61E-06	2.83E-06	6.79E-09
Thalami	8.06E-06	8.07E-06	8.10E-06	8.08E-06	3.00E-08	8.92E-06	8.02E-06	1.49E-06	1.00E-06	1.84E-05	8.63E-06	2.12E-08
Thyroid	8.96E-07	8.97E-07	8.98E-07	8.98E-07	1.32E-09	9.74E-07	8.88E-07	1.66E-07	8.52E-08	2.28E-06	9.61E-07	2.02E-09
Trunk	1.51E-08	1.51E-08	1.52E-08	1.51E-08	3.05E-11	1.71E-08	1.51E-08	2.85E-09	1.09E-09	5.25E-08	1.66E-08	3.62E-11
White Matter	9.33E-06	9.35E-06	9.37E-06	9.35E-06	3.41E-08	4.35E-05	9.96E-06	1.73E-06	1.07E-06	2.20E-05	1.15E-05	2.53E-08

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	1.43E-06	5.26E-05	2.43E-06	1.75E-05	1.33E-06	2.79E-05	6.21E-06	3.66E-05	1.30E-06	1.11E-06	1.35E-06	2.96E-06
Caud. Nucl.	1.06E-06	7.29E-06	1.52E-06	7.78E-06	5.36E-07	1.62E-05	2.98E-06	1.67E-05	5.22E-07	6.76E-07	8.79E-07	1.89E-06
Cerebellum	1.57E-06	6.93E-05	2.74E-06	2.09E-05	1.58E-06	3.19E-05	7.29E-06	4.36E-05	1.56E-06	1.26E-06	1.51E-06	3.33E-06
Cereb. Cort.	1.70E-06	9.80E-05	3.03E-06	2.62E-05	1.83E-06	3.76E-05	9.09E-06	5.47E-05	1.97E-06	1.45E-06	1.71E-06	3.78E-06
Cranium	2.48E-06	1.42E-04	5.71E-06	3.52E-05	5.33E-06	4.52E-05	1.17E-05	7.06E-05	4.19E-06	3.21E-06	3.60E-06	4.76E-06
Eyes	5.47E-07	4.48E-06	7.11E-07	4.81E-06	9.00E-08	9.89E-06	1.78E-06	1.03E-05	1.69E-07	2.75E-07	3.78E-07	1.10E-06
Lent. Nucl.	1.12E-06	8.01E-06	1.68E-06	8.35E-06	6.60E-07	1.71E-05	3.23E-06	1.74E-05	5.83E-07	7.36E-07	9.52E-07	2.05E-06
Mandible	4.39E-07	2.47E-06	5.45E-07	2.56E-06	1.30E-07	5.26E-06	9.95E-07	5.46E-06	2.09E-07	3.43E-07	4.27E-07	6.66E-07
Other Tissues	3.06E-07	2.70E-06	4.15E-07	2.61E-06	8.85E-08	5.42E-06	9.71E-07	5.63E-06	1.16E-07	1.72E-07	2.30E-07	5.97E-07
Skin	5.13E-07	6.01E-06	7.44E-07	4.76E-06	2.09E-07	9.86E-06	1.75E-06	1.02E-05	2.14E-07	2.86E-07	3.85E-07	1.06E-06
Spinal Col.	2.74E-07	2.40E-06	3.55E-07	2.39E-06	5.04E-08	4.92E-06	8.75E-07	5.13E-06	9.04E-08	1.47E-07	1.99E-07	5.36E-07
Spinal Skel.	4.22E-07	2.32E-06	5.35E-07	2.33E-06	1.55E-07	4.81E-06	9.23E-07	4.96E-06	2.22E-07	3.55E-07	4.36E-07	6.25E-07
Thalami	1.10E-06	7.42E-06	1.60E-06	7.87E-06	5.63E-07	1.61E-05	3.08E-06	1.65E-05	5.51E-07	7.31E-07	9.45E-07	2.00E-06
Thyroid	8.88E-08	8.20E-07	1.13E-07	8.96E-07	3.83E-09	1.85E-06	3.22E-07	1.94E-06	2.10E-08	3.94E-08	5.62E-08	1.92E-07
Trunk	1.13E-09	1.42E-08	1.48E-09	1.89E-08	1.37E-11	3.48E-08	5.14E-09	3.94E-08	2.10E-10	3.83E-10	5.94E-10	2.75E-09
White Matter	1.18E-06	9.37E-06	1.87E-06	9.25E-06	8.67E-07	1.89E-05	3.49E-06	1.94E-05	6.69E-07	7.93E-07	1.02E-06	2.19E-06

Table B.76: S values for the Adult Phantom for Sources Located in the Cranium.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	1.68E-06	4.04E-10	1.09E-06	7.13E-09	4.62E-06	1.12E-06	3.95E-07	3.45E-06	7.29E-07	3.82E-07	3.19E-06	5.98E-08
Caud. Nucl.	2.43E-08	3.11E-10	1.91E-08	2.58E-09	4.60E-08	8.94E-07	2.40E-07	2.65E-06	5.46E-07	1.65E-07	4.30E-07	4.66E-08
Cerebellum	2.13E-06	4.29E-10	1.37E-06	6.12E-09	5.95E-06	1.19E-06	4.54E-07	3.66E-06	7.95E-07	4.33E-07	3.97E-06	6.36E-08
Cereb. Cort.	3.45E-06	4.88E-10	2.24E-06	1.24E-08	9.48E-06	1.24E-06	4.83E-07	3.89E-06	8.35E-07	5.94E-07	6.07E-06	6.69E-08
Cranium	1.98E-04	2.49E-05	1.70E-04	6.21E-05	2.49E-04	7.73E-06	5.31E-06	6.74E-05	8.88E-05	1.07E-04	2.19E-04	1.50E-03
Eyes	2.15E-08	2.16E-11	1.64E-08	9.93E-10	4.53E-08	5.60E-07	6.00E-08	1.87E-06	2.57E-07	9.51E-08	2.96E-07	3.08E-08
Lent. Nucl.	2.84E-08	1.67E-10	2.18E-08	2.42E-09	5.62E-08	9.71E-07	2.57E-07	2.87E-06	5.86E-07	1.79E-07	4.66E-07	5.03E-08
Mandible	2.65E-07	1.68E-09	1.91E-07	1.63E-08	5.68E-07	4.42E-07	1.07E-07	1.03E-06	3.30E-07	1.45E-07	5.38E-07	2.10E-08
Other Tissues	1.18E-06	7.78E-09	8.64E-07	7.85E-08	2.31E-06	3.25E-07	7.39E-08	1.09E-06	2.88E-07	3.38E-07	1.71E-06	1.78E-08
Skin	1.29E-05	8.06E-08	9.64E-06	8.60E-07	2.28E-05	6.17E-07	2.02E-07	2.88E-06	1.63E-06	3.32E-06	1.66E-05	3.87E-08
Spinal Col.	8.21E-07	4.01E-09	6.05E-07	5.54E-08	1.68E-06	2.95E-07	4.99E-08	9.45E-07	2.29E-07	2.49E-07	1.24E-06	1.65E-08
Spinal Skel.	6.18E-07	3.18E-09	4.50E-07	3.61E-08	1.25E-06	4.41E-07	1.36E-07	1.02E-06	3.89E-07	2.30E-07	9.98E-07	2.07E-08
Thalami	3.31E-08	5.27E-10	2.53E-08	2.75E-09	5.85E-08	9.69E-07	2.32E-07	2.74E-06	5.79E-07	1.79E-07	4.57E-07	5.04E-08
Thyroid	3.25E-09	1.44E-12	2.53E-09	2.94E-10	6.34E-09	9.79E-08	5.43E-09	3.37E-07	3.83E-08	1.58E-08	5.36E-08	5.32E-09
Trunk	3.78E-11	1.22E-13	2.96E-11	1.83E-12	7.46E-11	1.10E-09	1.09E-11	5.07E-09	3.41E-10	1.64E-10	8.11E-10	6.24E-11
White Matter	3.20E-08	3.26E-10	2.46E-08	2.70E-09	6.84E-08	1.01E-06	3.13E-07	3.04E-06	6.29E-07	1.87E-07	4.94E-07	5.34E-08

Table B.77: S values for the Adult Phantom for Sources Located in the Lateral Ventricles.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.55E-05	7.68E-05	1.03E-04	5.09E-05	7.55E-05	4.17E-04	1.63E-04	1.77E-05	1.98E-05	1.22E-04	1.78E-04	2.75E-05
Caud. Nucl.	5.84E-05	5.91E-05	6.61E-05	5.82E-05	7.09E-06	1.47E-03	1.49E-04	1.08E-05	6.60E-06	1.89E-04	1.98E-04	2.01E-07
Cerebellum	8.75E-06	8.77E-06	8.79E-06	8.77E-06	2.97E-08	9.67E-06	8.71E-06	1.62E-06	1.06E-06	1.99E-05	9.39E-06	2.34E-08
Cereb. Cort.	1.29E-05	1.29E-05	1.31E-05	1.29E-05	1.49E-07	5.61E-05	1.48E-05	2.39E-06	1.55E-06	3.08E-05	1.70E-05	3.55E-08
Cranium	6.83E-06	6.84E-06	6.87E-06	6.84E-06	3.71E-08	7.65E-06	6.83E-06	1.26E-06	1.15E-06	1.56E-05	7.36E-06	2.11E-08
Eyes	4.03E-06	4.04E-06	4.05E-06	4.04E-06	1.01E-08	4.45E-06	4.01E-06	7.49E-07	4.51E-07	9.74E-06	4.34E-06	1.04E-08
Lent. Nucl.	3.75E-05	3.76E-05	3.90E-05	3.75E-05	1.37E-06	3.42E-04	5.47E-05	6.93E-06	4.37E-06	9.51E-05	6.67E-05	1.09E-07
Mandible	2.44E-06	2.44E-06	2.45E-06	2.44E-06	9.34E-09	2.71E-06	2.43E-06	4.52E-07	3.87E-07	5.71E-06	2.62E-06	6.55E-09
Other Tissues	2.20E-06	2.21E-06	2.21E-06	2.21E-06	6.14E-09	2.43E-06	2.19E-06	4.08E-07	2.48E-07	5.17E-06	2.37E-06	5.59E-09
Skin	3.11E-06	3.12E-06	3.12E-06	3.12E-06	8.77E-09	3.44E-06	3.09E-06	5.77E-07	3.26E-07	7.22E-06	3.34E-06	7.87E-09
Spinal Col.	1.96E-06	1.96E-06	1.97E-06	1.96E-06	6.92E-09	2.17E-06	1.95E-06	3.62E-07	2.32E-07	4.48E-06	2.09E-06	5.73E-09
Spinal Skel.	1.92E-06	1.92E-06	1.93E-06	1.92E-06	7.94E-09	2.13E-06	1.91E-06	3.55E-07	3.20E-07	4.37E-06	2.06E-06	5.12E-09
Thalami	5.37E-05	5.49E-05	6.07E-05	5.30E-05	7.23E-06	7.25E-04	1.03E-04	9.83E-06	6.08E-06	1.48E-04	1.28E-04	4.04E-07
Thyroid	9.42E-07	9.43E-07	9.46E-07	9.44E-07	2.97E-09	1.07E-06	9.39E-07	1.74E-07	9.84E-08	2.38E-06	1.01E-06	2.18E-09
Trunk	1.78E-08	1.78E-08	1.79E-08	1.79E-08	3.19E-11	2.00E-08	1.77E-08	3.36E-09	1.22E-09	6.30E-08	1.96E-08	4.26E-11
White Matter	3.30E-05	3.67E-05	4.91E-05	2.98E-05	1.96E-05	4.31E-04	9.59E-05	6.00E-06	3.92E-06	9.81E-05	1.13E-04	2.26E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.79E-06	1.37E-04	8.50E-06	4.48E-05	5.54E-06	7.98E-05	2.98E-05	1.02E-04	1.67E-05	9.59E-06	7.69E-06	1.63E-05
Caud. Nucl.	7.46E-06	1.38E-04	1.43E-05	6.23E-05	1.00E-05	1.16E-04	2.18E-05	1.22E-04	5.51E-06	5.49E-06	6.88E-06	1.37E-05
Cerebellum	1.17E-06	8.07E-06	1.72E-06	8.58E-06	6.48E-07	1.76E-05	3.31E-06	1.81E-05	6.21E-07	8.14E-07	1.04E-06	2.11E-06
Cereb. Cort.	1.72E-06	1.38E-05	2.72E-06	1.29E-05	1.30E-06	2.61E-05	4.88E-06	2.69E-05	1.02E-06	1.21E-06	1.54E-06	3.11E-06
Cranium	1.38E-06	6.39E-06	2.06E-06	6.91E-06	1.10E-06	1.38E-05	2.76E-06	1.41E-05	1.08E-06	1.49E-06	1.77E-06	1.94E-06
Eyes	4.85E-07	3.70E-06	6.03E-07	4.03E-06	4.29E-08	8.32E-06	1.50E-06	8.68E-06	1.36E-07	2.42E-07	3.34E-07	9.42E-07
Lent. Nucl.	4.90E-06	5.10E-05	8.77E-06	3.80E-05	5.49E-06	7.53E-05	1.41E-05	7.78E-05	3.44E-06	3.55E-06	4.49E-06	8.89E-06
Mandible	4.66E-07	2.24E-06	5.34E-07	2.38E-06	7.83E-08	4.94E-06	9.69E-07	5.08E-06	1.95E-07	3.49E-07	4.37E-07	6.68E-07
Other Tissues	2.72E-07	2.02E-06	3.43E-07	2.16E-06	4.31E-08	4.50E-06	8.16E-07	4.65E-06	9.03E-08	1.51E-07	2.03E-07	5.10E-07
Skin	3.48E-07	2.85E-06	4.59E-07	3.04E-06	7.08E-08	6.36E-06	1.14E-06	6.58E-06	1.19E-07	1.91E-07	2.58E-07	6.97E-07
Spinal Col.	2.52E-07	1.79E-06	3.14E-07	1.84E-06	3.17E-08	3.81E-06	7.37E-07	3.84E-06	7.66E-08	1.31E-07	1.79E-07	4.73E-07
Spinal Skel.	3.88E-07	1.76E-06	4.41E-07	1.85E-06	6.61E-08	3.87E-06	7.73E-07	3.96E-06	1.65E-07	2.96E-07	3.69E-07	5.41E-07
Thalami	6.77E-06	9.44E-05	1.26E-05	5.54E-05	8.49E-06	1.06E-04	1.99E-05	1.11E-04	4.96E-06	4.97E-06	6.25E-06	1.24E-05
Thyroid	1.06E-07	8.65E-07	1.30E-07	9.39E-07	5.19E-09	1.88E-06	3.43E-07	1.94E-06	2.72E-08	5.09E-08	7.09E-08	2.11E-07
Trunk	1.25E-09	1.67E-08	1.66E-09	2.24E-08	1.28E-11	4.14E-08	5.99E-09	4.70E-08	2.33E-10	4.28E-10	6.62E-10	3.14E-09
White Matter	3.69E-06	8.38E-05	6.56E-06	3.43E-05	4.07E-06	5.98E-05	1.17E-05	6.92E-05	2.78E-06	2.81E-06	3.48E-06	6.86E-06

Table B.78: S values for the Adult Phantom for Sources Located in the Lentiform Nuclei.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.32E-05	7.46E-05	1.01E-04	4.87E-05	7.55E-05	4.14E-04	1.61E-04	1.73E-05	1.95E-05	1.17E-04	1.76E-04	2.75E-05
Caud. Nucl.	1.30E-04	1.62E-04	2.71E-04	1.01E-04	1.73E-04	3.25E-03	6.81E-04	2.32E-05	1.52E-05	4.92E-04	8.09E-04	2.01E-05
Cerebellum	5.69E-06	5.69E-06	5.71E-06	5.70E-06	1.87E-08	6.27E-06	5.65E-06	1.05E-06	6.87E-07	1.29E-05	6.09E-06	1.51E-08
Cereb. Cort.	1.07E-05	1.08E-05	1.08E-05	1.08E-05	4.49E-08	3.48E-05	1.14E-05	1.99E-06	1.30E-06	2.50E-05	1.28E-05	2.92E-08
Cranium	7.55E-06	7.56E-06	7.59E-06	7.56E-06	4.18E-08	9.41E-06	7.56E-06	1.40E-06	1.26E-06	1.71E-05	8.17E-06	2.36E-08
Eyes	6.91E-06	6.92E-06	6.94E-06	6.92E-06	2.34E-08	7.61E-06	6.88E-06	1.28E-06	8.00E-07	1.62E-05	7.43E-06	1.75E-08
Lent. Nucl.	3.29E-03	4.03E-03	5.61E-03	2.29E-03	5.09E-03	1.41E-02	8.52E-03	1.04E-03	1.31E-03	4.60E-03	8.96E-03	2.03E-03
Mandible	4.59E-06	4.59E-06	4.61E-06	4.60E-06	1.91E-08	5.11E-06	4.57E-06	8.49E-07	7.26E-07	1.05E-05	4.93E-06	1.32E-08
Other Tissues	3.47E-06	3.48E-06	3.48E-06	3.48E-06	1.01E-08	3.83E-06	3.45E-06	6.43E-07	4.02E-07	8.02E-06	3.73E-06	8.93E-09
Skin	3.06E-06	3.06E-06	3.07E-06	3.06E-06	8.15E-09	3.37E-06	3.04E-06	5.67E-07	3.16E-07	7.12E-06	3.29E-06	7.64E-09
Spinal Col.	2.01E-06	2.01E-06	2.01E-06	2.01E-06	5.06E-09	2.19E-06	1.99E-06	3.70E-07	2.35E-07	4.30E-06	2.14E-06	5.90E-09
Spinal Skel.	2.03E-06	2.03E-06	2.04E-06	2.03E-06	9.02E-09	2.25E-06	2.02E-06	3.74E-07	3.78E-07	4.42E-06	2.17E-06	5.78E-09
Thalami	1.32E-04	1.61E-04	2.60E-04	1.05E-04	1.57E-04	3.18E-03	6.28E-04	2.36E-05	1.55E-05	4.80E-04	7.49E-04	1.83E-05
Thyroid	1.39E-06	1.39E-06	1.39E-06	1.39E-06	5.06E-09	1.54E-06	1.38E-06	2.58E-07	1.70E-07	3.50E-06	1.50E-06	3.73E-09
Trunk	2.40E-08	2.41E-08	2.41E-08	2.41E-08	4.33E-11	2.71E-08	2.39E-08	4.53E-09	1.84E-09	8.13E-08	2.64E-08	5.78E-11
White Matter	2.81E-05	3.06E-05	3.93E-05	2.59E-05	1.36E-05	3.49E-04	7.32E-05	5.12E-06	3.34E-06	8.10E-05	8.65E-05	1.57E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.51E-06	1.34E-04	7.99E-06	4.25E-05	5.23E-06	7.53E-05	2.90E-05	9.78E-05	1.65E-05	9.36E-06	7.41E-06	1.58E-05
Caud. Nucl.	1.08E-05	5.84E-04	2.16E-05	1.41E-04	1.61E-05	2.00E-04	4.20E-05	2.76E-04	1.05E-05	9.07E-06	1.08E-05	2.13E-05
Cerebellum	7.60E-07	5.22E-06	1.03E-06	5.51E-06	2.76E-07	1.14E-05	2.14E-06	1.17E-05	3.42E-07	5.00E-07	6.46E-07	1.37E-06
Cereb. Cort.	1.44E-06	1.06E-05	2.23E-06	1.06E-05	9.97E-07	2.17E-05	4.07E-06	2.23E-05	8.13E-07	9.87E-07	1.26E-06	2.60E-06
Cranium	1.51E-06	7.12E-06	2.46E-06	7.75E-06	1.56E-06	1.52E-05	3.05E-06	1.55E-05	1.31E-06	1.65E-06	1.96E-06	2.13E-06
Eyes	8.72E-07	6.34E-06	1.08E-06	6.70E-06	8.73E-08	1.41E-05	2.59E-06	1.45E-05	2.53E-07	4.45E-07	6.09E-07	1.64E-06
Lent. Nucl.	1.62E-04	6.93E-03	2.99E-04	1.66E-03	2.20E-04	2.87E-03	1.66E-03	4.24E-03	1.14E-03	5.82E-04	3.99E-04	8.69E-04
Mandible	8.68E-07	4.23E-06	1.07E-06	4.48E-06	2.74E-07	9.31E-06	1.82E-06	9.55E-06	4.40E-07	7.24E-07	8.91E-07	1.25E-06
Other Tissues	4.41E-07	3.18E-06	5.75E-07	3.38E-06	1.06E-07	7.06E-06	1.30E-06	7.27E-06	1.65E-07	2.59E-07	3.43E-07	8.18E-07
Skin	3.39E-07	2.80E-06	4.40E-07	2.99E-06	5.64E-08	6.28E-06	1.11E-06	6.52E-06	1.08E-07	1.76E-07	2.40E-07	6.79E-07
Spinal Col.	2.59E-07	1.83E-06	3.22E-07	1.83E-06	3.61E-08	3.98E-06	7.51E-07	4.01E-06	8.17E-08	1.37E-07	1.85E-07	4.76E-07
Spinal Skel.	4.62E-07	1.86E-06	5.26E-07	1.90E-06	9.13E-08	4.01E-06	8.44E-07	4.03E-06	2.08E-07	3.71E-07	4.58E-07	6.15E-07
Thalami	1.17E-05	5.41E-04	2.32E-05	1.42E-04	1.71E-05	2.10E-04	4.34E-05	2.80E-04	1.09E-05	9.63E-06	1.16E-05	2.27E-05
Thyroid	1.85E-07	1.28E-06	2.25E-07	1.42E-06	1.28E-08	2.92E-06	5.33E-07	3.08E-06	4.84E-08	8.55E-08	1.20E-07	3.42E-07
Trunk	1.91E-09	2.25E-08	2.47E-09	2.94E-08	2.87E-11	5.51E-08	8.26E-09	6.19E-08	3.77E-10	6.96E-10	1.05E-09	4.49E-09
White Matter	3.27E-06	6.44E-05	5.75E-06	2.90E-05	3.50E-06	5.20E-05	1.01E-05	5.89E-05	2.37E-06	2.44E-06	3.04E-06	6.02E-06

Table B.79: S values for the Adult Phantom for Sources Located in the Spinal CSF.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	2.63E-06	2.64E-06	2.64E-06	2.64E-06	7.42E-09	3.80E-06	2.64E-06	4.88E-07	2.95E-07	6.20E-06	2.87E-06	6.71E-09
Caud. Nucl.	2.37E-06	2.37E-06	2.38E-06	2.37E-06	7.98E-09	2.60E-06	2.36E-06	4.39E-07	2.69E-07	5.40E-06	2.54E-06	6.20E-09
Cerebellum	3.82E-06	3.83E-06	3.84E-06	3.83E-06	1.14E-08	4.29E-06	3.81E-06	7.09E-07	4.36E-07	9.07E-06	4.12E-06	9.88E-09
Cereb. Cort.	2.50E-06	2.51E-06	2.51E-06	2.51E-06	7.08E-09	4.83E-06	2.53E-06	4.64E-07	2.76E-07	5.96E-06	2.78E-06	6.42E-09
Cranium	3.21E-06	3.36E-06	3.86E-06	3.08E-06	7.90E-07	2.03E-05	5.83E-06	5.89E-07	4.81E-07	8.44E-06	6.70E-06	9.43E-08
Eyes	1.19E-06	1.19E-06	1.19E-06	1.19E-06	2.60E-09	1.34E-06	1.18E-06	2.20E-07	1.17E-07	3.10E-06	1.27E-06	3.50E-09
Lent. Nucl.	3.24E-06	3.24E-06	3.25E-06	3.24E-06	9.83E-09	3.65E-06	3.22E-06	5.99E-07	3.80E-07	7.31E-06	3.48E-06	8.07E-09
Mandible	3.39E-06	3.39E-06	3.40E-06	3.39E-06	1.42E-08	3.79E-06	3.38E-06	6.27E-07	5.29E-07	7.86E-06	3.64E-06	9.46E-09
Other Tissues	9.52E-06	9.53E-06	9.55E-06	9.54E-06	2.77E-08	1.27E-05	9.51E-06	1.76E-06	1.08E-06	2.19E-05	1.03E-05	2.44E-08
Skin	2.92E-06	2.93E-06	2.93E-06	2.93E-06	7.83E-09	3.23E-06	2.91E-06	5.41E-07	2.95E-07	6.83E-06	3.14E-06	7.25E-09
Spinal Col.	5.49E-04	8.04E-04	1.65E-03	3.19E-04	1.35E-03	9.78E-03	4.20E-03	9.39E-05	6.53E-05	2.31E-03	4.72E-03	1.54E-04
Spinal Skel.	9.88E-05	1.19E-04	1.89E-04	8.07E-05	1.09E-04	2.16E-03	4.45E-04	1.77E-05	1.34E-05	3.50E-04	5.28E-04	1.22E-05
Thalami	4.35E-06	4.35E-06	4.37E-06	4.36E-06	1.36E-08	4.87E-06	4.33E-06	8.04E-07	4.91E-07	1.00E-05	4.67E-06	1.07E-08
Thyroid	7.91E-06	7.92E-06	7.95E-06	7.93E-06	2.77E-08	8.80E-06	7.87E-06	1.46E-06	9.38E-07	1.81E-05	8.49E-06	2.05E-08
Trunk	2.62E-07	2.64E-07	2.70E-07	2.61E-07	9.28E-09	5.26E-07	2.91E-07	4.86E-08	2.81E-08	6.72E-07	3.21E-07	1.59E-09
White Matter	2.45E-06	2.46E-06	2.46E-06	2.46E-06	6.68E-09	2.72E-06	2.44E-06	4.55E-07	2.77E-07	5.72E-06	2.64E-06	6.21E-09

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	3.22E-07	2.43E-06	4.07E-07	2.58E-06	4.77E-08	5.40E-06	9.78E-07	5.59E-06	1.02E-07	1.70E-07	2.31E-07	6.11E-07
Caud. Nucl.	2.93E-07	2.17E-06	3.58E-07	2.28E-06	2.17E-08	4.76E-06	8.82E-07	4.89E-06	7.81E-08	1.39E-07	1.93E-07	5.55E-07
Cerebellum	4.73E-07	3.51E-06	5.98E-07	3.77E-06	6.89E-08	7.90E-06	1.43E-06	8.21E-06	1.49E-07	2.51E-07	3.40E-07	8.99E-07
Cereb. Cort.	3.00E-07	2.34E-06	3.84E-07	2.46E-06	5.06E-08	5.15E-06	9.26E-07	5.35E-06	9.63E-08	1.57E-07	2.14E-07	5.75E-07
Cranium	5.44E-07	5.20E-06	7.54E-07	3.27E-06	3.10E-07	6.26E-06	1.23E-06	6.77E-06	3.30E-07	4.73E-07	5.77E-07	8.15E-07
Eyes	1.22E-07	1.09E-06	1.53E-07	1.22E-06	1.42E-09	2.41E-06	4.32E-07	2.52E-06	2.28E-08	4.13E-08	6.41E-08	2.61E-07
Lent. Nucl.	4.20E-07	2.97E-06	5.15E-07	3.10E-06	4.83E-08	6.61E-06	1.21E-06	6.81E-06	1.29E-07	2.24E-07	3.03E-07	7.68E-07
Mandible	6.36E-07	3.11E-06	7.20E-07	3.29E-06	8.98E-08	6.84E-06	1.34E-06	7.01E-06	2.60E-07	4.79E-07	5.99E-07	9.18E-07
Other Tissues	1.17E-06	8.78E-06	1.56E-06	9.25E-06	3.10E-07	1.93E-05	3.54E-06	1.99E-05	4.51E-07	6.93E-07	9.17E-07	2.22E-06
Skin	3.15E-07	2.68E-06	4.11E-07	2.85E-06	5.12E-08	5.95E-06	1.06E-06	6.16E-06	9.89E-08	1.62E-07	2.22E-07	6.41E-07
Spinal Col.	2.50E-05	3.50E-03	5.13E-05	6.18E-04	3.99E-05	6.29E-04	1.53E-04	1.19E-03	3.56E-05	2.69E-05	2.96E-05	5.77E-05
Spinal Skel.	1.20E-05	3.85E-04	2.75E-05	1.12E-04	2.59E-05	1.62E-04	3.41E-05	2.11E-04	1.57E-05	1.45E-05	1.67E-05	1.94E-05
Thalami	5.46E-07	3.98E-06	6.78E-07	4.17E-06	8.03E-08	8.80E-06	1.60E-06	9.04E-06	1.83E-07	3.14E-07	4.17E-07	1.00E-06
Thyroid	1.03E-06	7.25E-06	1.32E-06	7.64E-06	2.17E-07	1.60E-05	2.97E-06	1.64E-05	3.83E-07	6.25E-07	8.22E-07	1.89E-06
Trunk	3.04E-08	2.67E-07	3.90E-08	2.68E-07	5.41E-09	5.43E-07	9.58E-08	5.74E-07	9.86E-09	1.59E-08	2.16E-08	5.84E-08
White Matter	3.03E-07	2.25E-06	3.79E-07	2.39E-06	4.03E-08	5.00E-06	9.12E-07	5.17E-06	9.39E-08	1.60E-07	2.17E-07	5.71E-07

Table B.80: S values for the Adult Phantom for Sources Located in the Spinal Skeleton.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{99m}Tc	^{131}Cs	^{131}I	^{153}Sm	^{186}Re	^{188}Re	^{226}Ra
Brain (Total)	8.70E-09	4.98E-11	6.68E-09	6.04E-10	1.72E-08	3.15E-07	2.41E-08	9.55E-07	1.41E-07	5.26E-08	1.53E-07	1.66E-08
Caud. Nucl.	9.67E-09	1.00E-10	7.56E-09	6.16E-10	1.78E-08	2.88E-07	1.18E-08	8.69E-07	1.22E-07	4.80E-08	1.38E-07	1.55E-08
Cerebellum	1.31E-08	9.01E-11	1.00E-08	8.83E-10	2.60E-08	4.68E-07	3.62E-08	1.45E-06	2.13E-07	7.89E-08	2.29E-07	2.49E-08
Cereb. Cort.	8.27E-09	4.73E-11	6.37E-09	5.98E-10	1.71E-08	2.92E-07	2.50E-08	9.01E-07	1.31E-07	4.87E-08	1.43E-07	1.55E-08
Cranium	6.16E-07	3.71E-09	4.47E-07	3.82E-08	1.27E-06	5.30E-07	1.51E-07	1.21E-06	4.53E-07	2.48E-07	1.04E-06	2.50E-08
Eyes	1.93E-09	1.37E-12	1.62E-09	2.79E-10	5.16E-09	1.18E-07	1.06E-09	4.52E-07	3.69E-08	1.74E-08	6.59E-08	6.70E-09
Lent. Nucl.	1.12E-08	6.45E-12	8.16E-09	5.34E-10	2.24E-08	4.05E-07	2.42E-08	1.19E-06	1.88E-07	6.89E-08	1.91E-07	2.11E-08
Mandible	1.57E-08	1.89E-10	1.20E-08	1.42E-09	2.98E-08	6.42E-07	7.34E-08	1.37E-06	4.08E-07	1.26E-07	2.56E-07	2.94E-08
Other Tissues	2.15E-06	1.30E-08	1.57E-06	1.34E-07	4.39E-06	1.26E-06	2.98E-07	3.94E-06	9.05E-07	7.14E-07	3.47E-06	6.77E-08
Skin	9.64E-09	6.75E-11	7.44E-09	6.84E-10	1.80E-08	3.20E-07	4.51E-08	1.08E-06	1.53E-07	5.43E-08	1.67E-07	1.74E-08
Spinal Col.	3.02E-06	2.69E-09	1.43E-06	2.15E-08	2.56E-05	7.83E-06	3.43E-06	2.43E-05	5.07E-06	1.41E-06	1.34E-05	4.21E-07
Spinal Skel.	6.97E-04	8.21E-05	5.90E-04	2.07E-04	9.10E-04	2.94E-05	2.17E-05	2.33E-04	3.01E-04	3.63E-04	7.81E-04	4.92E-03
Thalami	1.49E-08	1.23E-10	1.13E-08	1.03E-09	2.82E-08	5.43E-07	4.34E-08	1.56E-06	2.47E-07	9.10E-08	2.52E-07	2.88E-08
Thyroid	3.24E-08	1.19E-10	2.52E-08	2.37E-09	5.76E-08	1.03E-06	1.62E-07	2.99E-06	5.57E-07	1.85E-07	4.86E-07	5.34E-08
Trunk	7.37E-09	3.96E-11	5.36E-09	4.25E-10	1.52E-08	2.91E-08	2.75E-09	9.22E-08	1.38E-08	6.33E-09	2.37E-08	1.54E-09
White Matter	7.97E-09	4.33E-11	6.10E-09	5.52E-10	1.51E-08	2.96E-07	2.05E-08	8.83E-07	1.32E-07	4.94E-08	1.42E-07	1.55E-08

Table B.81: S values for the Adult Phantom for Sources Located in the Thalami.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.44E-05	7.58E-05	1.02E-04	4.99E-05	7.55E-05	4.16E-04	1.62E-04	1.75E-05	1.97E-05	1.20E-04	1.77E-04	2.75E-05
Caud. Nucl.	5.39E-05	5.64E-05	6.95E-05	5.24E-05	1.58E-05	1.19E-03	1.57E-04	9.78E-06	6.02E-06	1.79E-04	1.99E-04	5.96E-07
Cerebellum	8.75E-06	8.76E-06	8.78E-06	8.77E-06	2.87E-08	9.64E-06	8.70E-06	1.62E-06	1.07E-06	1.99E-05	9.38E-06	2.32E-08
Cereb. Cort.	1.09E-05	1.09E-05	1.09E-05	1.09E-05	3.73E-08	1.44E-05	1.09E-05	2.01E-06	1.31E-06	2.46E-05	1.18E-05	2.94E-08
Cranium	7.24E-06	7.25E-06	7.28E-06	7.25E-06	4.04E-08	8.12E-06	7.23E-06	1.34E-06	1.24E-06	1.64E-05	7.80E-06	2.30E-08
Eyes	4.99E-06	4.99E-06	5.00E-06	5.00E-06	1.19E-08	5.49E-06	4.95E-06	9.23E-07	5.51E-07	1.14E-05	5.33E-06	1.21E-08
Lent. Nucl.	1.32E-04	1.61E-04	2.60E-04	1.05E-04	1.57E-04	3.16E-03	6.30E-04	2.36E-05	1.55E-05	4.80E-04	7.51E-04	1.84E-05
Mandible	4.00E-06	4.00E-06	4.01E-06	4.00E-06	1.68E-08	4.44E-06	3.98E-06	7.40E-07	6.47E-07	9.16E-06	4.29E-06	1.15E-08
Other Tissues	3.68E-06	3.69E-06	3.70E-06	3.69E-06	1.08E-08	4.07E-06	3.66E-06	6.82E-07	4.28E-07	8.50E-06	3.95E-06	9.49E-09
Skin	2.99E-06	2.99E-06	3.00E-06	3.00E-06	8.16E-09	3.28E-06	2.97E-06	5.54E-07	3.10E-07	6.97E-06	3.21E-06	7.53E-09
Spinal Col.	3.12E-06	3.13E-06	3.13E-06	3.13E-06	7.13E-09	3.42E-06	3.11E-06	5.79E-07	3.72E-07	7.31E-06	3.35E-06	7.99E-09
Spinal Skel.	3.19E-06	3.20E-06	3.21E-06	3.20E-06	1.54E-08	3.54E-06	3.18E-06	5.90E-07	5.50E-07	7.11E-06	3.43E-06	9.34E-09
Thalami	4.07E-03	4.99E-03	6.99E-03	2.83E-03	6.33E-03	1.78E-02	1.07E-02	1.28E-03	1.61E-03	5.78E-03	1.12E-02	2.49E-03
Thyroid	1.71E-06	1.71E-06	1.71E-06	1.71E-06	3.95E-09	1.86E-06	1.70E-06	3.15E-07	1.57E-07	3.78E-06	1.82E-06	4.27E-09
Trunk	2.61E-08	2.61E-08	2.62E-08	2.62E-08	5.46E-11	2.95E-08	2.60E-08	4.92E-09	2.03E-09	8.80E-08	2.87E-08	6.29E-11
White Matter	2.86E-05	3.10E-05	3.89E-05	2.66E-05	1.25E-05	3.44E-04	7.04E-05	5.23E-06	3.39E-06	8.11E-05	8.33E-05	1.47E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.66E-06	1.36E-04	8.25E-06	4.37E-05	5.38E-06	7.77E-05	2.95E-05	1.00E-04	1.66E-05	9.48E-06	7.56E-06	1.60E-05
Caud. Nucl.	6.74E-06	1.41E-04	1.27E-05	5.91E-05	8.75E-06	1.06E-04	1.97E-05	1.17E-04	4.92E-06	4.98E-06	6.22E-06	1.22E-05
Cerebellum	1.18E-06	8.06E-06	1.70E-06	8.54E-06	5.88E-07	1.76E-05	3.31E-06	1.80E-05	6.04E-07	8.17E-07	1.05E-06	2.13E-06
Cereb. Cort.	1.45E-06	1.01E-05	2.21E-06	1.07E-05	9.42E-07	2.19E-05	4.11E-06	2.25E-05	8.12E-07	1.01E-06	1.29E-06	2.62E-06
Cranium	1.49E-06	6.80E-06	2.31E-06	7.37E-06	1.36E-06	1.46E-05	2.94E-06	1.49E-05	1.23E-06	1.61E-06	1.91E-06	2.07E-06
Eyes	5.92E-07	4.55E-06	7.31E-07	4.78E-06	4.10E-08	1.01E-05	1.85E-06	1.03E-05	1.57E-07	2.85E-07	3.96E-07	1.16E-06
Lent. Nucl.	1.17E-05	5.43E-04	2.32E-05	1.42E-04	1.72E-05	2.10E-04	4.35E-05	2.79E-04	1.09E-05	9.63E-06	1.16E-05	2.28E-05
Mandible	7.78E-07	3.68E-06	9.28E-07	3.89E-06	2.01E-07	8.05E-06	1.59E-06	8.24E-06	3.74E-07	6.41E-07	7.90E-07	1.11E-06
Other Tissues	4.71E-07	3.38E-06	6.13E-07	3.58E-06	1.13E-07	7.49E-06	1.38E-06	7.71E-06	1.78E-07	2.79E-07	3.69E-07	8.70E-07
Skin	3.34E-07	2.74E-06	4.29E-07	2.92E-06	5.09E-08	6.10E-06	1.09E-06	6.32E-06	1.06E-07	1.76E-07	2.40E-07	6.64E-07
Spinal Col.	4.05E-07	2.86E-06	5.22E-07	3.07E-06	8.31E-08	6.27E-06	1.18E-06	6.45E-06	1.40E-07	2.20E-07	2.97E-07	7.54E-07
Spinal Skel.	6.71E-07	2.94E-06	7.98E-07	3.06E-06	1.90E-07	6.42E-06	1.29E-06	6.53E-06	3.39E-07	5.75E-07	7.04E-07	9.12E-07
Thalami	2.01E-04	8.70E-03	3.71E-04	2.08E-03	2.73E-04	3.57E-03	2.04E-03	5.28E-03	1.39E-03	7.14E-04	4.90E-04	1.07E-03
Thyroid	1.72E-07	1.55E-06	2.13E-07	1.58E-06	1.34E-08	3.30E-06	5.93E-07	3.32E-06	4.97E-08	9.02E-08	1.23E-07	3.48E-07
Trunk	2.13E-09	2.44E-08	2.74E-09	3.19E-08	3.43E-11	5.99E-08	9.00E-09	6.73E-08	4.24E-10	7.77E-10	1.17E-09	4.91E-09
White Matter	3.36E-06	6.23E-05	5.91E-06	2.95E-05	3.60E-06	5.34E-05	1.03E-05	5.99E-05	2.43E-06	2.51E-06	3.13E-06	6.18E-06

Table B.82: S values for the Adult Phantom for Sources Located in the Third Ventricle.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.51E-05	7.64E-05	1.03E-04	5.06E-05	7.55E-05	4.16E-04	1.63E-04	1.77E-05	1.98E-05	1.21E-04	1.78E-04	2.75E-05
Caud. Nucl.	4.19E-05	4.19E-05	4.21E-05	4.20E-05	1.55E-07	5.50E-05	4.19E-05	7.76E-06	5.08E-06	9.52E-05	4.54E-05	1.17E-07
Cerebellum	9.03E-06	9.04E-06	9.06E-06	9.04E-06	3.11E-08	9.99E-06	8.98E-06	1.67E-06	1.10E-06	2.05E-05	9.68E-06	2.42E-08
Cereb. Cort.	1.09E-05	1.09E-05	1.09E-05	1.09E-05	3.70E-08	1.22E-05	1.08E-05	2.01E-06	1.32E-06	2.46E-05	1.17E-05	2.92E-08
Cranium	7.04E-06	7.05E-06	7.08E-06	7.05E-06	3.81E-08	7.88E-06	7.03E-06	1.30E-06	1.21E-06	1.59E-05	7.58E-06	2.21E-08
Eyes	4.83E-06	4.84E-06	4.85E-06	4.84E-06	1.28E-08	5.34E-06	4.81E-06	8.96E-07	5.42E-07	1.13E-05	5.20E-06	1.24E-08
Lent. Nucl.	6.07E-05	6.08E-05	6.09E-05	6.08E-05	2.45E-07	4.58E-04	6.81E-05	1.12E-05	7.04E-06	1.44E-04	8.21E-05	1.76E-07
Mandible	3.64E-06	3.64E-06	3.65E-06	3.64E-06	1.52E-08	4.07E-06	3.63E-06	6.73E-07	5.99E-07	8.35E-06	3.91E-06	1.02E-08
Other Tissues	3.37E-06	3.37E-06	3.38E-06	3.37E-06	9.92E-09	3.71E-06	3.35E-06	6.23E-07	3.93E-07	7.78E-06	3.61E-06	8.63E-09
Skin	2.99E-06	3.00E-06	3.00E-06	3.00E-06	8.05E-09	3.29E-06	2.98E-06	5.55E-07	3.11E-07	6.98E-06	3.22E-06	7.45E-09
Spinal Col.	3.55E-06	3.56E-06	3.57E-06	3.56E-06	1.11E-08	3.85E-06	3.53E-06	6.55E-07	3.70E-07	7.76E-06	3.79E-06	9.06E-09
Spinal Skel.	3.06E-06	3.07E-06	3.08E-06	3.07E-06	1.52E-08	3.40E-06	3.05E-06	5.66E-07	5.34E-07	6.94E-06	3.29E-06	8.72E-09
Thalami	2.07E-04	2.20E-04	3.36E-04	2.00E-04	1.21E-04	1.05E-02	1.31E-03	3.74E-05	2.21E-05	1.08E-03	1.71E-03	1.46E-06
Thyroid	1.32E-06	1.32E-06	1.32E-06	1.32E-06	5.95E-09	1.50E-06	1.31E-06	2.44E-07	1.51E-07	3.33E-06	1.42E-06	3.46E-09
Trunk	2.53E-08	2.53E-08	2.54E-08	2.53E-08	5.22E-11	2.86E-08	2.51E-08	4.76E-09	1.88E-09	8.55E-08	2.77E-08	6.06E-11
White Matter	4.47E-05	5.58E-05	8.89E-05	3.45E-05	5.61E-05	4.82E-04	1.76E-04	7.99E-06	5.42E-06	1.34E-04	1.97E-04	7.15E-06

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.75E-06	1.36E-04	8.41E-06	4.44E-05	5.47E-06	7.90E-05	2.97E-05	1.02E-04	1.67E-05	9.55E-06	7.65E-06	1.62E-05
Caud. Nucl.	5.66E-06	3.93E-05	1.02E-05	4.26E-05	6.46E-06	8.49E-05	1.60E-05	8.73E-05	4.07E-06	4.14E-06	5.23E-06	1.02E-05
Cerebellum	1.22E-06	8.32E-06	1.77E-06	8.83E-06	6.37E-07	1.82E-05	3.42E-06	1.87E-05	6.37E-07	8.46E-07	1.08E-06	2.19E-06
Cereb. Cort.	1.46E-06	1.00E-05	2.20E-06	1.07E-05	9.14E-07	2.19E-05	4.12E-06	2.24E-05	8.12E-07	1.02E-06	1.31E-06	2.63E-06
Cranium	1.45E-06	6.59E-06	2.20E-06	7.14E-06	1.22E-06	1.41E-05	2.86E-06	1.44E-05	1.16E-06	1.57E-06	1.86E-06	2.02E-06
Eyes	5.87E-07	4.43E-06	7.21E-07	4.74E-06	4.32E-08	1.00E-05	1.80E-06	1.04E-05	1.59E-07	2.85E-07	3.96E-07	1.13E-06
Lent. Nucl.	7.89E-06	6.50E-05	1.48E-05	6.12E-05	1.00E-05	1.22E-04	2.29E-05	1.25E-04	5.87E-06	5.71E-06	7.22E-06	1.44E-05
Mandible	7.19E-07	3.35E-06	8.46E-07	3.54E-06	1.62E-07	7.38E-06	1.46E-06	7.57E-06	3.30E-07	5.74E-07	7.11E-07	1.02E-06
Other Tissues	4.32E-07	3.09E-06	5.57E-07	3.28E-06	9.48E-08	6.84E-06	1.26E-06	7.05E-06	1.59E-07	2.55E-07	3.37E-07	7.96E-07
Skin	3.33E-07	2.74E-06	4.30E-07	2.92E-06	5.08E-08	6.11E-06	1.09E-06	6.33E-06	1.05E-07	1.74E-07	2.38E-07	6.67E-07
Spinal Col.	4.12E-07	3.24E-06	5.18E-07	3.30E-06	6.72E-08	7.07E-06	1.28E-06	7.18E-06	1.39E-07	2.31E-07	3.09E-07	7.74E-07
Spinal Skel.	6.51E-07	2.82E-06	7.69E-07	2.96E-06	1.73E-07	6.17E-06	1.25E-06	6.30E-06	3.20E-07	5.46E-07	6.70E-07	8.85E-07
Thalami	2.54E-05	1.17E-03	5.28E-05	2.63E-04	4.21E-05	4.09E-04	7.47E-05	4.90E-04	1.98E-05	1.98E-05	2.41E-05	4.64E-05
Thyroid	1.64E-07	1.21E-06	1.99E-07	1.34E-06	1.10E-08	2.75E-06	4.93E-07	2.89E-06	4.61E-08	8.53E-08	1.16E-07	3.10E-07
Trunk	1.95E-09	2.36E-08	2.54E-09	3.10E-08	2.92E-11	5.81E-08	8.63E-09	6.54E-08	3.79E-10	6.92E-10	1.06E-09	4.64E-09
White Matter	3.80E-06	1.49E-04	6.81E-06	4.55E-05	4.26E-06	6.85E-05	1.46E-05	9.19E-05	3.41E-06	3.11E-06	3.76E-06	7.45E-06

Table B.83: S values for the Adult Phantom for Sources Located in the Thyroid.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{125m}I	^{126}I	^{130}I	^{131}I	^{132}I	^{132m}I	^{133}I
Brain (Total)	1.03E-07	8.81E-07	1.27E-07	9.78E-07	5.61E-09	3.96E-07	4.54E-09	2.01E-06	3.45E-07	2.12E-06	2.94E-07	5.68E-07
Caud. Nucl.	1.41E-07	1.18E-06	1.75E-07	1.25E-06	5.88E-09	5.25E-07	4.86E-09	2.63E-06	4.73E-07	2.71E-06	3.84E-07	7.53E-07
Cerebellum	8.81E-08	7.94E-07	1.09E-07	8.84E-07	2.37E-09	3.56E-07	2.24E-09	1.82E-06	3.08E-07	1.92E-06	2.65E-07	5.13E-07
Cereb. Cort.	9.35E-08	8.29E-07	1.16E-07	9.20E-07	5.30E-09	3.73E-07	4.24E-09	1.90E-06	3.23E-07	2.00E-06	2.78E-07	5.36E-07
Cranium	1.57E-07	8.51E-07	1.82E-07	9.47E-07	2.38E-08	3.93E-07	1.81E-08	1.94E-06	3.58E-07	2.04E-06	2.94E-07	5.47E-07
Eyes	1.14E-07	1.21E-06	1.47E-07	1.33E-06	1.28E-09	5.32E-07	1.43E-09	2.72E-06	4.61E-07	2.84E-06	3.93E-07	7.75E-07
Lent. Nucl.	1.82E-07	1.43E-06	2.25E-07	1.54E-06	1.24E-08	6.38E-07	9.80E-09	3.18E-06	5.78E-07	3.29E-06	4.68E-07	9.11E-07
Mandible	7.66E-07	3.68E-06	1.03E-06	3.93E-06	3.98E-07	1.74E-06	2.73E-07	8.01E-06	1.58E-06	8.20E-06	1.29E-06	2.30E-06
Other Tissues	1.44E-06	3.23E-05	2.51E-06	1.37E-05	1.48E-06	5.69E-06	8.28E-07	2.43E-05	4.68E-06	2.79E-05	4.23E-06	9.17E-06
Skin	3.20E-07	2.64E-06	5.05E-07	2.83E-06	2.17E-07	1.21E-06	1.29E-07	5.78E-06	1.04E-06	5.97E-06	8.90E-07	1.65E-06
Spinal Col.	9.80E-07	7.14E-06	1.27E-06	7.47E-06	2.03E-07	3.20E-06	1.45E-07	1.56E-05	2.92E-06	1.60E-05	2.34E-06	4.49E-06
Spinal Skel.	1.52E-06	7.20E-06	2.12E-06	7.71E-06	9.26E-07	3.45E-06	6.29E-07	1.57E-05	3.11E-06	1.61E-05	2.56E-06	4.49E-06
Thalami	2.02E-07	1.41E-06	2.50E-07	1.53E-06	2.00E-08	6.40E-07	1.52E-08	3.16E-06	5.90E-07	3.29E-06	4.70E-07	9.00E-07
Thyroid	1.58E-04	6.66E-03	2.91E-04	1.61E-03	2.14E-04	1.24E-03	5.35E-04	2.79E-03	1.61E-03	4.11E-03	1.27E-03	3.22E-03
Trunk	5.60E-08	4.52E-07	7.71E-08	4.61E-07	2.05E-08	1.92E-07	1.31E-08	9.35E-07	1.68E-07	9.80E-07	1.42E-07	2.68E-07
White Matter	1.09E-07	9.14E-07	1.34E-07	1.02E-06	5.99E-09	4.11E-07	4.86E-09	2.08E-06	3.60E-07	2.20E-06	3.05E-07	5.90E-07

Table B.84: S values for the Adult Phantom for Sources Located in the White Matter.

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{11}C	^{13}N	^{15}O	^{18}F	^{32}P	^{57}Cu	^{62}Cu	^{64}Cu	^{67}Cu	^{76}Br	^{82}Rb	^{85}Kr
Brain (Total)	6.15E-05	7.28E-05	9.92E-05	4.70E-05	7.55E-05	4.08E-04	1.59E-04	1.70E-05	1.93E-05	1.14E-04	1.74E-04	2.75E-05
Caud. Nucl.	3.34E-05	3.71E-05	4.97E-05	3.01E-05	1.99E-05	4.72E-04	9.79E-05	6.09E-06	3.97E-06	9.96E-05	1.16E-04	2.38E-06
Cerebellum	7.94E-06	7.95E-06	7.97E-06	7.95E-06	2.64E-08	1.37E-05	7.99E-06	1.47E-06	9.33E-07	1.81E-05	8.72E-06	2.09E-08
Cereb. Cort.	1.53E-05	1.64E-05	2.03E-05	1.43E-05	6.06E-06	1.71E-04	3.61E-05	2.80E-06	1.78E-06	4.31E-05	4.27E-05	7.03E-07
Cranium	8.08E-06	8.10E-06	8.13E-06	8.09E-06	4.60E-08	1.87E-05	8.27E-06	1.50E-06	1.28E-06	1.87E-05	9.13E-06	2.57E-08
Eyes	5.69E-06	5.70E-06	5.71E-06	5.71E-06	1.15E-08	6.25E-06	5.66E-06	1.05E-06	6.06E-07	1.31E-05	6.09E-06	1.38E-08
Lent. Nucl.	2.80E-05	3.05E-05	3.91E-05	2.57E-05	1.36E-05	3.47E-04	7.31E-05	5.10E-06	3.30E-06	8.03E-05	8.63E-05	1.58E-06
Mandible	2.66E-06	2.66E-06	2.67E-06	2.66E-06	9.80E-09	2.96E-06	2.65E-06	4.92E-07	4.09E-07	6.24E-06	2.86E-06	7.30E-09
Other Tissues	2.35E-06	2.35E-06	2.36E-06	2.35E-06	6.30E-09	2.61E-06	2.33E-06	4.35E-07	2.61E-07	5.49E-06	2.52E-06	5.90E-09
Skin	3.55E-06	3.55E-06	3.56E-06	3.55E-06	9.77E-09	3.91E-06	3.53E-06	6.57E-07	3.65E-07	8.21E-06	3.81E-06	9.00E-09
Spinal Col.	1.90E-06	1.90E-06	1.91E-06	1.91E-06	5.88E-09	2.11E-06	1.90E-06	3.52E-07	2.23E-07	4.53E-06	2.05E-06	4.52E-09
Spinal Skel.	1.89E-06	1.89E-06	1.90E-06	1.89E-06	7.73E-09	2.10E-06	1.88E-06	3.50E-07	3.12E-07	4.27E-06	2.03E-06	5.26E-09
Thalami	2.84E-05	3.06E-05	3.85E-05	2.64E-05	1.23E-05	3.39E-04	7.07E-05	5.18E-06	3.34E-06	8.07E-05	8.37E-05	1.42E-06
Thyroid	9.39E-07	9.40E-07	9.42E-07	9.41E-07	2.09E-09	1.05E-06	9.33E-07	1.74E-07	9.64E-08	2.35E-06	1.01E-06	2.42E-09
Trunk	1.68E-08	1.68E-08	1.69E-08	1.69E-08	3.10E-11	1.91E-08	1.67E-08	3.18E-09	1.20E-09	5.87E-08	1.86E-08	4.07E-11
White Matter	1.21E-04	1.46E-04	2.02E-04	8.93E-05	1.66E-04	7.25E-04	3.20E-04	3.54E-05	4.20E-05	2.05E-04	3.44E-04	6.23E-05

	S values (mGy MBq^{-1}s^{-1})											
Targets	^{99m}Tc	^{122}I	^{123}I	^{124}I	^{125}I	^{130}I	^{131}I	^{132}I	^{133}Xe	^{197}Hg	^{201}Tl	^{203}Hg
Brain (Total)	4.24E-06	1.33E-04	7.57E-06	4.08E-05	5.01E-06	7.18E-05	2.83E-05	9.43E-05	1.64E-05	9.16E-06	7.16E-06	1.53E-05
Caud. Nucl.	3.72E-06	8.58E-05	6.67E-06	3.47E-05	4.19E-06	6.03E-05	1.19E-05	7.00E-05	2.81E-06	2.79E-06	3.47E-06	6.93E-06
Cerebellum	1.03E-06	7.43E-06	1.57E-06	7.77E-06	6.58E-07	1.59E-05	2.98E-06	1.62E-05	5.66E-07	7.08E-07	9.08E-07	1.89E-06
Cereb. Cort.	1.77E-06	3.20E-05	3.01E-06	1.57E-05	1.68E-06	2.88E-05	5.52E-06	3.21E-05	1.18E-06	1.27E-06	1.60E-06	3.31E-06
Cranium	1.52E-06	7.85E-06	2.71E-06	8.46E-06	1.95E-06	1.63E-05	3.24E-06	1.67E-05	1.45E-06	1.69E-06	1.99E-06	2.22E-06
Eyes	6.55E-07	5.20E-06	8.36E-07	5.48E-06	9.54E-08	1.14E-05	2.08E-06	1.17E-05	2.02E-07	3.34E-07	4.58E-07	1.28E-06
Lent. Nucl.	3.20E-06	6.43E-05	5.68E-06	2.88E-05	3.50E-06	5.15E-05	1.00E-05	5.82E-05	2.36E-06	2.40E-06	2.99E-06	5.95E-06
Mandible	4.89E-07	2.45E-06	5.80E-07	2.62E-06	1.09E-07	5.45E-06	1.05E-06	5.63E-06	2.18E-07	3.76E-07	4.69E-07	7.14E-07
Other Tissues	2.85E-07	2.15E-06	3.69E-07	2.30E-06	6.04E-08	4.79E-06	8.68E-07	4.96E-06	1.01E-07	1.61E-07	2.15E-07	5.40E-07
Skin	3.91E-07	3.26E-06	5.35E-07	3.47E-06	1.13E-07	7.27E-06	1.29E-06	7.53E-06	1.48E-07	2.20E-07	2.95E-07	7.85E-07
Spinal Col.	2.50E-07	1.75E-06	3.08E-07	1.87E-06	3.51E-08	3.88E-06	7.11E-07	4.02E-06	7.67E-08	1.25E-07	1.72E-07	4.48E-07
Spinal Skel.	3.72E-07	1.74E-06	4.44E-07	1.82E-06	9.14E-08	3.79E-06	7.63E-07	3.86E-06	1.73E-07	2.98E-07	3.69E-07	5.36E-07
Thalami	3.31E-06	6.25E-05	5.80E-06	2.90E-05	3.50E-06	5.28E-05	1.02E-05	5.90E-05	2.38E-06	2.46E-06	3.07E-06	6.12E-06
Thyroid	1.04E-07	8.61E-07	1.28E-07	9.36E-07	5.18E-09	1.95E-06	3.41E-07	2.04E-06	2.65E-08	4.90E-08	6.85E-08	2.07E-07
Trunk	1.24E-09	1.58E-08	1.63E-09	2.11E-08	1.37E-11	3.96E-08	5.73E-09	4.49E-08	2.28E-10	4.15E-10	6.46E-10	3.04E-09
White Matter	7.42E-06	2.64E-04	1.35E-05	7.34E-05	9.32E-06	1.28E-04	5.79E-05	1.75E-04	3.60E-05	1.94E-05	1.43E-05	3.08E-05

APPENDIX C
CHORD LENGTH DISTRIBUTION THROUGH MARROW CAVITIES AND BONE TRABECULAE IN SIX BONE SITES OF A 44 YEAR-OLD MALE

Table C.1: Chord lengths distribution in marrow cavity of trabecular bone.

Length (um)	Parietal bone	Cervical vertebrae	Lumbar vertebrae	Rib bone	Iliac crest	Femur head	Femur neck
100	4.94E-04	1.05E-04	2.23E-05	4.51E-05	6.80E-05	4.30E-05	3.55E-05
200	4.16E-04	7.88E-05	3.43E-05	2.89E-05	6.95E-05	4.06E-05	2.80E-05
300	3.63E-04	7.78E-05	3.58E-05	2.56E-05	7.08E-05	4.31E-05	2.39E-05
400	3.14E-04	7.97E-05	4.19E-05	2.44E-05	7.31E-05	4.69E-05	2.32E-05
500	2.53E-04	7.94E-05	5.78E-05	2.41E-05	7.44E-05	5.27E-05	2.33E-05
600	1.93E-04	7.64E-05	7.35E-05	2.50E-05	7.81E-05	5.88E-05	2.42E-05
700	1.55E-04	7.10E-05	7.47E-05	2.68E-05	8.25E-05	5.97E-05	2.53E-05
800	1.06E-04	6.18E-05	6.59E-05	2.59E-05	8.06E-05	5.71E-05	2.53E-05
900	8.14E-05	5.42E-05	5.39E-05	2.66E-05	7.01E-05	5.19E-05	2.49E-05
1000	5.42E-05	4.84E-05	4.45E-05	2.37E-05	5.84E-05	4.53E-05	2.43E-05
1100	3.95E-05	4.39E-05	3.22E-05	2.19E-05	5.80E-05	4.07E-05	2.27E-05
1200	2.71E-05	4.03E-05	2.93E-05	1.88E-05	4.86E-05	3.63E-05	2.19E-05
1300	1.83E-05	3.44E-05	2.40E-05	1.66E-05	4.02E-05	3.12E-05	2.15E-05
1400	1.41E-05	2.82E-05	2.08E-05	1.46E-05	3.04E-05	2.71E-05	1.91E-05
1500	1.11E-05	2.30E-05	1.76E-05	1.41E-05	2.70E-05	2.34E-05	1.74E-05
1600	7.10E-06	2.07E-05	1.52E-05	1.28E-05	2.32E-05	2.43E-05	1.63E-05
1700	6.30E-06	1.98E-05	1.34E-05	1.21E-05	2.02E-05	1.69E-05	1.50E-05
1800	4.32E-06	1.79E-05	1.17E-05	1.08E-05	1.66E-05	1.52E-05	1.39E-05
1900	2.57E-06	1.59E-05	1.01E-05	1.01E-05	1.45E-05	1.44E-05	1.26E-05
2000	2.03E-06	1.39E-05	9.01E-06	9.26E-06	1.26E-05	1.24E-05	1.16E-05
2100	1.21E-06	1.29E-05	8.10E-06	7.62E-06	1.11E-05	1.10E-05	1.13E-05
2200	1.77E-06	1.15E-05	7.51E-06	7.39E-06	1.02E-05	9.72E-06	1.04E-05
2300	1.75E-06	9.67E-06	7.10E-06	8.03E-06	9.73E-06	8.60E-06	9.54E-06
2400	1.11E-06	7.44E-06	6.44E-06	7.85E-06	8.63E-06	7.71E-06	8.94E-06
2500	6.17E-07	6.66E-06	5.96E-06	6.92E-06	6.64E-06	7.33E-06	7.95E-06
2600	4.63E-07	6.05E-06	5.69E-06	7.68E-06	5.86E-06	6.42E-06	7.80E-06
2700	5.40E-07	5.40E-06	5.18E-06	6.33E-06	4.65E-06	5.92E-06	7.31E-06
2800	4.89E-07	5.33E-06	4.82E-06	5.22E-06	3.87E-06	5.35E-06	6.54E-06
2900	4.11E-07	4.21E-06	4.66E-06	4.40E-06	3.43E-06	4.92E-06	6.45E-06
3000	1.03E-07	3.55E-06	4.37E-06	4.34E-06	3.43E-06	4.24E-06	5.95E-06
3100	7.71E-08	3.29E-06	3.65E-06	4.92E-06	2.99E-06	3.93E-06	5.44E-06
3200	1.03E-07	3.33E-06	3.75E-06	4.22E-06	2.43E-06	3.85E-06	4.76E-06
3300	2.31E-07	2.86E-06	3.40E-06	3.52E-06	2.32E-06	3.25E-06	4.51E-06
3400	2.57E-07	2.76E-06	3.13E-06	3.93E-06	1.66E-06	2.98E-06	4.33E-06
3500	2.83E-07	2.02E-06	2.98E-06	4.45E-06	1.55E-06	2.69E-06	4.13E-06
3600	7.71E-08	2.02E-06	2.79E-06	4.86E-06	1.55E-06	2.36E-06	3.63E-06
3700	5.14E-08	1.89E-06	2.72E-06	3.81E-06	1.11E-06	2.25E-06	3.31E-06
3800	2.57E-08	1.64E-06	2.54E-06	3.52E-06	7.74E-07	1.98E-06	3.39E-06
3900	0.00E+00	1.65E-06	2.43E-06	3.11E-06	5.53E-07	1.88E-06	3.16E-06
4000	0.00E+00	1.30E-06	2.10E-06	3.22E-06	7.74E-07	1.77E-06	3.02E-06
4100	0.00E+00	1.24E-06	1.97E-06	2.46E-06	9.96E-07	1.84E-06	2.99E-06
4200	0.00E+00	1.14E-06	1.89E-06	2.40E-06	8.85E-07	1.74E-06	2.75E-06
4300	0.00E+00	1.29E-06	1.73E-06	2.17E-06	5.53E-07	1.44E-06	2.70E-06
4400	0.00E+00	1.03E-06	1.60E-06	2.40E-06	4.42E-07	1.32E-06	2.39E-06
4500	0.00E+00	8.03E-07	1.66E-06	2.52E-06	3.32E-07	1.21E-06	2.07E-06
4600	0.00E+00	7.37E-07	1.47E-06	2.29E-06	4.42E-07	1.13E-06	2.00E-06
4700	0.00E+00	8.03E-07	1.47E-06	2.17E-06	3.32E-07	1.61E-06	2.22E-06
4800	0.00E+00	6.38E-07	1.25E-06	2.52E-06	2.21E-07	9.88E-07	2.01E-06
4900	0.00E+00	6.16E-07	1.30E-06	1.93E-06	3.32E-07	9.71E-07	1.92E-06

Table C.1: Continued.

Length (um)	**Parietal bone**	**Cervical vertebrae**	**Lumbar vertebrae**	**Rib bone**	**Iliac crest**	**Femur head**	**Femur neck**
5000	0.00E+00	2.97E-07	1.14E-06	1.76E-06	3.32E-07	9.71E-07	1.77E-06
5100	0.00E+00	4.07E-07	9.29E-07	1.64E-06	1.11E-07	7.82E-07	1.66E-06
5200	0.00E+00	7.37E-07	1.06E-06	1.76E-06	1.11E-07	6.45E-07	1.50E-06
5300	0.00E+00	5.94E-07	9.78E-07	1.58E-06	2.21E-07	6.19E-07	1.49E-06
5400	0.00E+00	3.52E-07	9.12E-07	1.41E-06	1.11E-07	6.36E-07	1.26E-06
5500	0.00E+00	3.74E-07	8.47E-07	1.88E-06	1.11E-07	5.59E-07	1.35E-06
5600	0.00E+00	1.76E-07	8.31E-07	2.05E-06	1.11E-07	4.73E-07	1.30E-06
5700	0.00E+00	1.87E-07	8.31E-07	1.88E-06	1.11E-07	5.16E-07	1.33E-06
5800	0.00E+00	6.60E-08	7.98E-07	1.70E-06	1.11E-07	4.81E-07	1.26E-06
5900	0.00E+00	1.32E-07	7.49E-07	1.58E-06	0.00E+00	4.13E-07	1.13E-06
6000	0.00E+00	1.43E-07	7.17E-07	1.64E-06	0.00E+00	3.27E-07	1.13E-06
6100	0.00E+00	1.21E-07	7.01E-07	1.47E-06	0.00E+00	3.18E-07	9.97E-07
6200	0.00E+00	6.60E-08	7.17E-07	1.35E-06	0.00E+00	3.18E-07	9.61E-07
6300	0.00E+00	7.70E-08	6.84E-07	1.11E-06	0.00E+00	3.44E-07	8.28E-07
6400	0.00E+00	6.60E-08	6.19E-07	1.11E-06	0.00E+00	2.92E-07	7.92E-07
6500	0.00E+00	6.60E-08	5.87E-07	8.21E-07	0.00E+00	3.18E-07	7.98E-07
6600	0.00E+00	5.50E-08	5.70E-07	7.62E-07	0.00E+00	3.78E-07	7.37E-07
6700	0.00E+00	6.60E-08	5.05E-07	7.62E-07	0.00E+00	2.92E-07	6.35E-07
6800	0.00E+00	7.70E-08	4.40E-07	9.96E-07	0.00E+00	3.18E-07	5.98E-07
6900	0.00E+00	7.70E-08	4.72E-07	1.06E-06	0.00E+00	3.09E-07	6.29E-07
7000	0.00E+00	9.90E-08	4.72E-07	1.06E-06	0.00E+00	3.18E-07	5.26E-07
7100	0.00E+00	1.10E-07	4.24E-07	9.38E-07	0.00E+00	2.75E-07	5.26E-07
7200	0.00E+00	5.50E-08	4.56E-07	7.62E-07	0.00E+00	2.32E-07	5.02E-07
7300	0.00E+00	4.40E-08	4.60E-07	7.62E-07	0.00E+00	1.37E-07	5.02E-07
7400	0.00E+00	4.40E-08	3.42E-07	7.62E-07	0.00E+00	1.98E-07	4.35E-07
7500	0.00E+00	3.30E-08	3.58E-07	5.28E-07	0.00E+00	1.98E-07	4.47E-07
7600	0.00E+00	2.20E-08	3.58E-07	4.69E-07	0.00E+00	1.29E-07	4.23E-07
7700	0.00E+00	1.10E-08	3.58E-07	5.86E-07	0.00E+00	1.72E-07	3.81E-07
7800	0.00E+00	1.10E-08	3.10E-07	5.28E-07	0.00E+00	2.75E-07	3.32E-07
7900	0.00E+00	1.10E-08	3.10E-07	6.45E-07	0.00E+00	1.29E-07	3.26E-07
8000	0.00E+00	2.20E-08	3.26E-07	6.45E-07	0.00E+00	1.37E-07	3.57E-07
8100	0.00E+00	1.10E-08	3.26E-07	6.45E-07	0.00E+00	1.72E-07	3.87E-07
8200	0.00E+00	0.00E+00	2.93E-07	5.86E-07	0.00E+00	1.80E-07	2.96E-07
8300	0.00E+00	0.00E+00	2.44E-07	4.10E-07	0.00E+00	1.37E-07	2.72E-07
8400	0.00E+00	0.00E+00	2.44E-07	3.52E-07	0.00E+00	1.46E-07	2.24E-07
8500	0.00E+00	0.00E+00	2.12E-07	4.69E-07	0.00E+00	1.29E-07	2.54E-07
8600	0.00E+00	0.00E+00	3.26E-07	4.10E-07	0.00E+00	4.30E-08	1.93E-07
8700	0.00E+00	0.00E+00	2.28E-07	4.69E-07	0.00E+00	1.63E-07	1.63E-07
8800	0.00E+00	0.00E+00	2.61E-07	4.10E-07	0.00E+00	1.80E-07	2.24E-07
8900	0.00E+00	0.00E+00	2.12E-07	4.10E-07	0.00E+00	7.74E-08	2.30E-07
9000	0.00E+00	0.00E+00	1.79E-07	4.10E-07	0.00E+00	4.30E-08	2.30E-07
9100	0.00E+00	0.00E+00	1.63E-07	2.34E-07	0.00E+00	4.30E-08	2.66E-07
9200	0.00E+00	0.00E+00	1.79E-07	2.34E-07	0.00E+00	4.30E-08	2.54E-07
9300	0.00E+00	0.00E+00	1.79E-07	2.93E-07	0.00E+00	5.15E-08	1.75E-07
9400	0.00E+00	0.00E+00	1.47E-07	3.52E-07	0.00E+00	6.02E-08	1.51E-07
9500	0.00E+00	0.00E+00	1.63E-07	2.34E-07	0.00E+00	7.74E-08	2.05E-07
9600	0.00E+00	0.00E+00	1.96E-07	2.34E-07	0.00E+00	3.44E-08	1.51E-07
9700	0.00E+00	0.00E+00	1.79E-07	2.34E-07	0.00E+00	7.74E-08	1.63E-07
9800	0.00E+00	0.00E+00	1.30E-07	2.34E-07	0.00E+00	7.74E-08	1.93E-07
9900	0.00E+00	0.00E+00	1.47E-07	1.76E-07	0.00E+00	1.72E-08	1.27E-07

Table C.2: Chord lengths distribution in bone trabeculae.

Length (um)	Parietal bone	Cervical vertebrae	Lumbar vertebrae	Rib bone	Iliac crest	Femur head	Femur neck
20	5.01E-06	9.16E-05	3.02E-04	1.54E-04	1.41E-04	5.09E-05	8.72E-05
40	5.12E-05	8.94E-05	2.61E-04	2.99E-04	1.36E-04	1.02E-04	1.88E-04
60	3.36E-05	8.98E-05	2.54E-04	1.67E-04	1.30E-04	1.10E-04	1.01E-04
80	3.35E-05	9.02E-05	2.43E-04	2.19E-04	1.01E-04	1.43E-04	8.74E-05
100	3.47E-05	1.20E-04	2.37E-04	3.13E-04	1.57E-04	2.28E-04	1.07E-04
120	3.66E-05	1.77E-04	2.33E-04	3.35E-04	2.42E-04	3.28E-04	1.36E-04
140	4.18E-05	2.24E-04	2.12E-04	2.92E-04	3.16E-04	4.10E-04	1.63E-04
160	4.44E-05	2.60E-04	2.06E-04	2.37E-04	3.36E-04	4.13E-04	1.78E-04
180	4.78E-05	2.65E-04	1.86E-04	1.93E-04	3.33E-04	3.82E-04	1.82E-04
200	5.15E-05	2.47E-04	1.72E-04	1.53E-04	2.97E-04	3.37E-04	1.77E-04
220	5.73E-05	2.28E-04	1.59E-04	1.25E-04	2.59E-04	2.73E-04	1.64E-04
240	6.00E-05	1.93E-04	1.41E-04	1.10E-04	2.20E-04	2.17E-04	1.51E-04
260	6.18E-05	1.65E-04	1.26E-04	9.48E-05	1.88E-04	1.76E-04	1.31E-04
280	6.32E-05	1.40E-04	1.12E-04	8.01E-05	1.56E-04	1.44E-04	1.15E-04
300	6.32E-05	1.20E-04	1.06E-04	7.45E-05	1.32E-04	1.17E-04	1.02E-04
320	6.09E-05	1.04E-04	9.48E-05	6.35E-05	1.09E-04	9.72E-05	8.79E-05
340	6.19E-05	9.05E-05	8.13E-05	5.51E-05	9.19E-05	8.29E-05	7.70E-05
360	6.15E-05	8.17E-05	7.36E-05	4.87E-05	7.37E-05	6.91E-05	6.92E-05
380	5.53E-05	7.10E-05	6.69E-05	4.18E-05	6.88E-05	6.08E-05	6.46E-05
400	5.23E-05	6.13E-05	5.91E-05	3.65E-05	5.89E-05	5.43E-05	5.70E-05
420	4.83E-05	5.54E-05	5.36E-05	3.28E-05	5.29E-05	4.77E-05	5.11E-05
440	4.51E-05	5.12E-05	4.90E-05	3.31E-05	4.50E-05	4.17E-05	4.64E-05
460	4.27E-05	4.57E-05	4.34E-05	3.19E-05	3.84E-05	3.67E-05	4.06E-05
480	4.03E-05	3.89E-05	4.07E-05	2.72E-05	3.46E-05	3.37E-05	3.81E-05
500	3.61E-05	3.62E-05	3.98E-05	2.27E-05	3.18E-05	3.07E-05	3.64E-05
520	3.58E-05	3.39E-05	3.47E-05	2.39E-05	3.15E-05	2.77E-05	3.27E-05
540	3.59E-05	2.95E-05	3.24E-05	2.36E-05	2.93E-05	2.45E-05	3.01E-05
560	3.27E-05	2.69E-05	2.84E-05	2.12E-05	2.82E-05	2.20E-05	2.66E-05
580	3.15E-05	2.58E-05	2.65E-05	2.16E-05	2.50E-05	2.11E-05	2.53E-05
600	2.98E-05	2.22E-05	2.63E-05	2.00E-05	2.19E-05	1.88E-05	2.39E-05
620	2.75E-05	2.15E-05	2.17E-05	2.03E-05	2.05E-05	1.74E-05	2.20E-05
640	2.50E-05	1.96E-05	1.95E-05	1.59E-05	1.95E-05	1.63E-05	2.18E-05
660	2.19E-05	1.81E-05	2.02E-05	1.57E-05	1.65E-05	1.46E-05	1.99E-05
680	2.28E-05	1.64E-05	2.03E-05	1.40E-05	1.66E-05	1.41E-05	1.81E-05
700	2.17E-05	1.63E-05	1.77E-05	1.35E-05	1.51E-05	1.27E-05	1.72E-05
720	2.14E-05	1.60E-05	1.48E-05	1.43E-05	1.29E-05	1.19E-05	1.68E-05
740	2.10E-05	1.44E-05	1.52E-05	1.25E-05	1.16E-05	1.07E-05	1.59E-05
760	1.94E-05	1.28E-05	1.39E-05	1.35E-05	9.63E-06	8.98E-06	1.46E-05
780	1.88E-05	1.16E-05	1.35E-05	1.46E-05	9.88E-06	8.46E-06	1.43E-05
800	1.78E-05	1.06E-05	1.07E-05	1.27E-05	8.96E-06	7.75E-06	1.36E-05
820	1.81E-05	9.93E-06	9.97E-06	1.11E-05	8.29E-06	7.40E-06	1.25E-05
840	1.64E-05	9.13E-06	1.00E-05	7.98E-06	7.45E-06	6.34E-06	1.25E-05
860	1.58E-05	7.82E-06	9.03E-06	7.46E-06	7.37E-06	6.34E-06	1.17E-05
880	1.51E-05	7.83E-06	9.88E-06	7.00E-06	6.11E-06	5.64E-06	1.06E-05
900	1.41E-05	7.76E-06	9.44E-06	6.55E-06	5.19E-06	5.11E-06	9.74E-06
920	1.40E-05	7.39E-06	8.10E-06	6.78E-06	3.85E-06	5.20E-06	9.04E-06
940	1.40E-05	6.45E-06	6.52E-06	6.10E-06	4.69E-06	4.40E-06	8.79E-06
960	1.37E-05	6.52E-06	7.01E-06	8.13E-06	4.27E-06	3.88E-06	8.02E-06
980	1.27E-05	6.09E-06	5.55E-06	5.72E-06	3.43E-06	3.44E-06	7.64E-06

Table C.2: Continued.

Length (um)	Parietal bone	Cervical vertebrae	Lumbar vertebrae	Rib bone	Iliac crest	Femur head	Femur neck
1000	1.22E-05	5.58E-06	6.08E-06	5.72E-06	3.52E-06	3.26E-06	6.81E-06
1020	1.27E-05	4.42E-06	5.15E-06	8.28E-06	3.35E-06	3.17E-06	6.69E-06
1040	1.27E-05	4.13E-06	6.24E-06	6.18E-06	3.52E-06	2.73E-06	6.18E-06
1060	1.12E-05	3.70E-06	6.68E-06	7.08E-06	3.01E-06	2.47E-06	5.92E-06
1080	1.12E-05	4.06E-06	6.77E-06	6.63E-06	2.85E-06	2.29E-06	5.92E-06
1100	1.02E-05	3.84E-06	6.60E-06	7.15E-06	2.43E-06	2.47E-06	6.18E-06
1120	8.53E-06	3.62E-06	4.66E-06	8.36E-06	1.84E-06	2.11E-06	5.73E-06
1140	7.67E-06	3.62E-06	4.70E-06	8.21E-06	1.67E-06	1.94E-06	5.16E-06
1160	8.25E-06	2.68E-06	3.85E-06	7.38E-06	1.59E-06	1.59E-06	4.90E-06
1180	7.90E-06	2.68E-06	3.12E-06	6.25E-06	1.42E-06	1.50E-06	4.90E-06
1200	7.86E-06	2.39E-06	3.48E-06	3.31E-06	1.17E-06	1.50E-06	4.78E-06
1220	7.12E-06	2.47E-06	2.92E-06	4.14E-06	1.67E-06	1.23E-06	4.20E-06
1240	6.73E-06	2.54E-06	3.12E-06	4.67E-06	1.59E-06	1.32E-06	3.95E-06
1260	6.81E-06	2.10E-06	2.59E-06	5.27E-06	1.34E-06	1.23E-06	3.50E-06
1280	5.67E-06	2.10E-06	2.51E-06	5.20E-06	1.09E-06	1.23E-06	3.31E-06
1300	5.28E-06	1.96E-06	2.23E-06	6.25E-06	1.17E-06	1.23E-06	3.57E-06
1320	5.40E-06	1.96E-06	1.90E-06	6.78E-06	1.09E-06	1.23E-06	3.38E-06
1340	5.59E-06	1.67E-06	1.54E-06	5.72E-06	9.21E-07	9.69E-07	3.31E-06
1360	5.32E-06	1.31E-06	1.86E-06	2.86E-06	8.37E-07	9.69E-07	2.93E-06
1380	5.48E-06	1.38E-06	1.82E-06	5.05E-06	6.70E-07	7.93E-07	2.99E-06
1400	4.85E-06	1.52E-06	2.15E-06	7.08E-06	5.86E-07	7.05E-07	2.67E-06
1420	4.73E-06	1.59E-06	1.62E-06	5.27E-06	5.86E-07	7.93E-07	2.87E-06
1440	4.81E-06	1.38E-06	2.43E-06	4.14E-06	6.70E-07	6.17E-07	2.67E-06
1460	4.97E-06	1.31E-06	2.15E-06	3.99E-06	5.03E-07	6.17E-07	2.61E-06
1480	4.73E-06	1.23E-06	1.99E-06	3.69E-06	8.37E-07	6.17E-07	2.61E-06
1500	4.69E-06	8.70E-07	1.05E-06	1.81E-06	6.70E-07	5.29E-07	2.42E-06
1520	3.25E-06	1.01E-06	1.54E-06	2.94E-06	5.86E-07	5.29E-07	2.23E-06
1540	3.36E-06	7.98E-07	1.70E-06	2.56E-06	7.54E-07	4.40E-07	2.23E-06
1560	3.21E-06	9.43E-07	7.66E-07	3.01E-06	5.03E-07	6.17E-07	1.91E-06
1580	3.44E-06	1.01E-06	6.48E-07	3.09E-06	4.19E-07	5.29E-07	1.91E-06
1600	3.01E-06	7.98E-07	1.26E-06	5.50E-06	5.03E-07	4.40E-07	1.72E-06
1620	2.78E-06	7.98E-07	1.30E-06	3.46E-06	5.03E-07	4.40E-07	1.66E-06
1640	2.89E-06	7.25E-07	1.17E-06	2.18E-06	5.86E-07	3.52E-07	1.78E-06
1660	2.89E-06	7.98E-07	7.70E-07	2.71E-06	5.03E-07	4.40E-07	1.72E-06
1680	2.74E-06	7.25E-07	9.72E-07	2.03E-06	4.19E-07	3.52E-07	1.66E-06
1700	2.54E-06	6.53E-07	7.70E-07	2.26E-06	2.51E-07	1.76E-07	1.53E-06
1720	2.27E-06	6.53E-07	1.13E-06	2.79E-06	3.35E-07	1.76E-07	1.40E-06
1740	2.43E-06	5.80E-07	7.70E-07	1.81E-06	2.51E-07	2.64E-07	1.53E-06
1760	2.43E-06	5.07E-07	9.72E-07	2.71E-06	3.35E-07	3.52E-07	1.46E-06
1780	1.80E-06	6.53E-07	8.91E-07	1.81E-06	3.35E-07	2.64E-07	1.21E-06
1800	1.99E-06	5.07E-07	9.72E-07	2.11E-06	1.68E-07	2.64E-07	1.21E-06
1820	1.72E-06	4.35E-07	4.46E-07	2.11E-06	8.36E-08	1.76E-07	1.08E-06
1840	1.64E-06	5.07E-07	2.43E-07	2.41E-06	8.36E-08	1.76E-07	1.21E-06
1860	1.92E-06	4.35E-07	3.65E-07	2.11E-06	1.68E-07	1.76E-07	1.02E-06
1880	1.92E-06	2.90E-07	4.05E-07	2.41E-06	8.36E-08	1.76E-07	1.02E-06
1900	1.53E-06	5.07E-07	7.29E-07	1.81E-06	8.36E-08	1.76E-07	9.55E-07
1920	1.25E-06	2.90E-07	8.91E-07	1.58E-06	1.68E-07	1.76E-07	9.55E-07
1940	1.33E-06	2.90E-07	2.43E-07	9.79E-07	8.36E-08	1.76E-07	1.02E-06
1960	1.60E-06	3.62E-07	2.43E-07	6.03E-07	1.68E-07	8.80E-08	7.64E-07
1980	1.64E-06	3.62E-07	2.03E-07	2.26E-06	8.36E-08	1.76E-07	8.92E-07

APPENDIX D
ELECTRON ABSORBED FRACTIONS OF ENERGY IN TRABECULAR BONE

Table D.1: Absorbed fractions of energy for monoenergetic electron in the TMS.

Target = TMS

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	9.98E-01	9.98E-01	9.99E-01	9.98E-01	9.98E-01	9.94E-01	9.99E-01
0.015	9.95E-01	9.96E-01	9.98E-01	9.95E-01	9.97E-01	9.87E-01	9.97E-01
0.020	9.92E-01	9.94E-01	9.96E-01	9.92E-01	9.94E-01	9.80E-01	9.96E-01
0.030	9.85E-01	9.89E-01	9.92E-01	9.84E-01	9.89E-01	9.61E-01	9.92E-01
0.050	9.64E-01	9.72E-01	9.81E-01	9.64E-01	9.74E-01	9.13E-01	9.81E-01
0.100	8.97E-01	9.15E-01	9.44E-01	8.92E-01	9.24E-01	7.63E-01	9.46E-01
0.200	7.58E-01	8.01E-01	8.61E-01	7.51E-01	8.29E-01	4.96E-01	8.79E-01
0.500	6.52E-01	7.27E-01	7.66E-01	6.63E-01	7.50E-01	3.16E-01	8.07E-01
1.000	6.27E-01	7.11E-01	7.40E-01	6.47E-01	7.24E-01	2.87E-01	7.77E-01
1.500	6.20E-01	7.06E-01	7.31E-01	6.41E-01	7.17E-01	2.75E-01	7.69E-01
2.000	6.16E-01	7.03E-01	7.30E-01	6.38E-01	7.13E-01	2.70E-01	7.66E-01
4.000	6.08E-01	6.94E-01	7.18E-01	6.30E-01	7.03E-01	2.63E-01	7.57E-01

Target = TBE

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	2.31E-03	1.61E-03	1.28E-03	2.40E-03	1.59E-03	6.18E-03	1.02E-03
0.015	4.62E-03	3.68E-03	2.31E-03	4.62E-03	3.37E-03	1.28E-02	2.54E-03
0.020	7.73E-03	5.77E-03	3.86E-03	7.53E-03	5.84E-03	2.02E-02	3.83E-03
0.030	1.32E-02	9.65E-03	7.34E-03	1.41E-02	9.48E-03	3.34E-02	6.94E-03
0.050	2.02E-02	1.54E-02	1.07E-02	2.01E-02	1.43E-02	4.70E-02	1.06E-02
0.100	2.68E-02	2.25E-02	1.55E-02	2.87E-02	2.03E-02	5.64E-02	1.50E-02
0.200	3.60E-02	3.35E-02	2.17E-02	4.12E-02	3.06E-02	5.16E-02	2.31E-02
0.500	4.75E-02	4.56E-02	3.19E-02	5.26E-02	4.02E-02	4.77E-02	3.11E-02
1.000	4.89E-02	4.65E-02	3.42E-02	5.38E-02	4.26E-02	4.75E-02	3.30E-02
1.500	4.95E-02	4.72E-02	3.44E-02	5.38E-02	4.26E-02	4.67E-02	3.38E-02
2.000	4.94E-02	4.72E-02	3.43E-02	5.41E-02	4.28E-02	4.64E-02	3.35E-02
4.000	4.93E-02	4.70E-02	3.47E-02	5.38E-02	4.30E-02	4.61E-02	3.40E-02

Target = TBV

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	8.91E-06	0.00E+00	0.00E+00	2.20E-07	0.00E+00	4.23E-05	0.00E+00
0.015	5.35E-05	1.20E-05	8.98E-06	1.16E-05	1.52E-05	1.23E-04	2.22E-05
0.020	9.40E-05	2.30E-05	7.54E-06	4.61E-05	5.47E-05	2.82E-04	1.53E-05
0.030	2.07E-03	1.32E-03	1.05E-03	1.90E-03	1.46E-03	5.52E-03	1.04E-03
0.050	1.56E-02	1.27E-02	8.07E-03	1.59E-02	1.17E-02	4.05E-02	8.11E-03
0.100	7.64E-02	6.22E-02	4.09E-02	7.89E-02	5.53E-02	1.80E-01	3.86E-02
0.200	2.05E-01	1.66E-01	1.17E-01	2.08E-01	1.40E-01	4.53E-01	9.76E-02
0.500	3.00E-01	2.26E-01	2.01E-01	2.83E-01	2.09E-01	6.35E-01	1.61E-01
1.000	3.20E-01	2.39E-01	2.23E-01	2.96E-01	2.30E-01	6.63E-01	1.87E-01
1.500	3.25E-01	2.42E-01	2.30E-01	3.00E-01	2.36E-01	6.73E-01	1.92E-01
2.000	3.27E-01	2.43E-01	2.29E-01	3.01E-01	2.37E-01	6.76E-01	1.94E-01
4.000	3.28E-01	2.44E-01	2.32E-01	3.02E-01	2.39E-01	6.73E-01	1.96E-01

Table D.2: Absorbed fractions of energy for monoenergetic electron in the TBE.

Target = TMS

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	3.75E-02	3.80E-02	3.95E-02	3.83E-02	3.81E-02	3.45E-02	3.84E-02
0.015	7.80E-02	7.96E-02	7.94E-02	7.78E-02	7.82E-02	7.10E-02	7.93E-02
0.020	1.27E-01	1.32E-01	1.33E-01	1.30E-01	1.32E-01	1.20E-01	1.31E-01
0.030	2.35E-01	2.40E-01	2.42E-01	2.41E-01	2.37E-01	2.17E-01	2.38E-01
0.050	3.41E-01	3.52E-01	3.52E-01	3.49E-01	3.47E-01	3.09E-01	3.48E-01
0.100	4.12E-01	4.32E-01	4.44E-01	4.35E-01	4.33E-01	3.41E-01	4.50E-01
0.200	4.96E-01	5.68E-01	5.50E-01	5.42E-01	5.67E-01	2.94E-01	5.99E-01
0.500	5.83E-01	6.62E-01	6.76E-01	6.20E-01	6.63E-01	2.67E-01	7.03E-01
1.000	5.96E-01	6.80E-01	7.00E-01	6.27E-01	6.85E-01	2.65E-01	7.32E-01
1.500	6.01E-01	6.86E-01	7.07E-01	6.29E-01	6.91E-01	2.61E-01	7.41E-01
2.000	6.03E-01	6.89E-01	7.10E-01	6.30E-01	6.94E-01	2.60E-01	7.46E-01
4.000	6.00E-01	6.87E-01	7.10E-01	6.27E-01	6.94E-01	2.58E-01	7.46E-01

Target = TBE

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	9.22E-01	9.21E-01	9.21E-01	9.22E-01	9.22E-01	9.26E-01	9.22E-01
0.015	8.39E-01	8.39E-01	8.38E-01	8.40E-01	8.38E-01	8.45E-01	8.38E-01
0.020	7.33E-01	7.28E-01	7.28E-01	7.31E-01	7.30E-01	7.41E-01	7.30E-01
0.030	5.08E-01	5.05E-01	5.04E-01	5.07E-01	5.08E-01	5.23E-01	5.10E-01
0.050	2.83E-01	2.75E-01	2.76E-01	2.81E-01	2.81E-01	2.95E-01	2.80E-01
0.100	1.20E-01	1.16E-01	1.17E-01	1.20E-01	1.24E-01	1.31E-01	1.25E-01
0.200	7.62E-02	7.59E-02	6.62E-02	7.74E-02	7.85E-02	6.91E-02	7.45E-02
0.500	5.82E-02	5.68E-02	4.55E-02	6.09E-02	5.48E-02	5.42E-02	4.75E-02
1.000	5.45E-02	5.29E-02	3.97E-02	5.79E-02	4.92E-02	5.02E-02	4.08E-02
1.500	5.20E-02	5.06E-02	3.75E-02	5.59E-02	4.67E-02	4.82E-02	3.80E-02
2.000	5.16E-02	4.97E-02	3.66E-02	5.54E-02	4.59E-02	4.75E-02	3.68E-02
4.000	5.04E-02	4.87E-02	3.57E-02	5.43E-02	4.47E-02	4.68E-02	3.56E-02

Target = TBV

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	4.06E-02	4.06E-02	3.95E-02	4.00E-02	4.04E-02	3.97E-02	3.98E-02
0.015	8.32E-02	8.19E-02	8.30E-02	8.24E-02	8.39E-02	8.40E-02	8.30E-02
0.020	1.40E-01	1.40E-01	1.39E-01	1.39E-01	1.38E-01	1.40E-01	1.38E-01
0.030	2.57E-01	2.56E-01	2.54E-01	2.52E-01	2.56E-01	2.60E-01	2.53E-01
0.050	3.77E-01	3.73E-01	3.73E-01	3.70E-01	3.72E-01	3.96E-01	3.71E-01
0.100	4.68E-01	4.52E-01	4.39E-01	4.44E-01	4.43E-01	5.29E-01	4.25E-01
0.200	4.27E-01	3.55E-01	3.84E-01	3.80E-01	3.54E-01	6.36E-01	3.26E-01
0.500	3.57E-01	2.80E-01	2.78E-01	3.18E-01	2.81E-01	6.77E-01	2.48E-01
1.000	3.46E-01	2.64E-01	2.57E-01	3.12E-01	2.63E-01	6.81E-01	2.25E-01
1.500	3.42E-01	2.58E-01	2.50E-01	3.10E-01	2.57E-01	6.85E-01	2.16E-01
2.000	3.39E-01	2.54E-01	2.46E-01	3.08E-01	2.54E-01	6.84E-01	2.11E-01
4.000	3.35E-01	2.50E-01	2.39E-01	3.04E-01	2.47E-01	6.78E-01	2.04E-01

Table D.3: Absorbed fractions of energy for monoenergetic electron in the TBV.

Target = TMS

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	0.00E+00	6.59E-06	0.00E+00	7.21E-06	0.00E+00	0.00E+00	0.00E+00
0.015	1.39E-05	3.46E-05	4.67E-06	2.98E-05	1.24E-05	0.00E+00	1.87E-05
0.020	1.01E-05	1.69E-05	2.02E-05	4.59E-05	1.64E-05	3.22E-06	1.35E-05
0.030	2.87E-03	3.45E-03	2.52E-03	3.30E-03	3.42E-03	1.32E-03	3.08E-03
0.050	2.49E-02	3.09E-02	2.36E-02	2.99E-02	2.92E-02	1.30E-02	2.65E-02
0.100	1.30E-01	1.64E-01	1.17E-01	1.50E-01	1.48E-01	6.36E-02	1.33E-01
0.200	3.60E-01	4.52E-01	3.41E-01	4.19E-01	3.83E-01	1.70E-01	3.46E-01
0.500	5.41E-01	6.27E-01	5.96E-01	5.83E-01	5.92E-01	2.41E-01	5.89E-01
1.000	5.79E-01	6.65E-01	6.68E-01	6.13E-01	6.56E-01	2.53E-01	6.85E-01
1.500	5.88E-01	6.76E-01	6.85E-01	6.19E-01	6.71E-01	2.52E-01	7.10E-01
2.000	5.93E-01	6.81E-01	6.94E-01	6.23E-01	6.81E-01	2.53E-01	7.23E-01
4.000	5.96E-01	6.84E-01	7.02E-01	6.24E-01	6.88E-01	2.54E-01	7.35E-01

Target = TBE

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	3.75E-03	4.70E-03	3.30E-03	4.42E-03	4.06E-03	2.06E-03	3.93E-03
0.015	7.73E-03	9.37E-03	6.71E-03	8.61E-03	8.79E-03	4.35E-03	7.63E-03
0.020	1.26E-02	1.50E-02	1.14E-02	1.42E-02	1.38E-02	6.94E-03	1.30E-02
0.030	2.23E-02	2.71E-02	1.92E-02	2.58E-02	2.53E-02	1.21E-02	2.33E-02
0.050	3.48E-02	4.25E-02	3.16E-02	4.05E-02	4.05E-02	2.00E-02	3.66E-02
0.100	5.15E-02	6.22E-02	4.38E-02	5.72E-02	5.67E-02	3.00E-02	4.88E-02
0.200	5.74E-02	6.13E-02	4.68E-02	6.21E-02	5.54E-02	4.17E-02	4.74E-02
0.500	5.30E-02	5.31E-02	4.02E-02	5.65E-02	4.88E-02	4.65E-02	4.11E-02
1.000	5.18E-02	5.01E-02	3.76E-02	5.54E-02	4.67E-02	4.66E-02	3.77E-02
1.500	5.10E-02	4.96E-02	3.67E-02	5.48E-02	4.58E-02	4.62E-02	3.64E-02
2.000	5.06E-02	4.89E-02	3.61E-02	5.46E-02	4.45E-02	4.62E-02	3.58E-02
4.000	4.99E-02	4.81E-02	3.54E-02	5.38E-02	4.39E-02	4.61E-02	3.50E-02

Target = TBV

Energy (MeV)	Cervical Vertebrae	Femur Head	Femur Neck	Iliac Crest	Lumbar Vertebrae	Parietal Bone	Rib Bone
0.010	9.96E-01	9.95E-01	9.97E-01	9.96E-01	9.96E-01	9.98E-01	9.96E-01
0.015	9.92E-01	9.91E-01	9.93E-01	9.91E-01	9.91E-01	9.96E-01	9.92E-01
0.020	9.87E-01	9.85E-01	9.89E-01	9.86E-01	9.86E-01	9.93E-01	9.87E-01
0.030	9.75E-01	9.69E-01	9.78E-01	9.71E-01	9.71E-01	9.87E-01	9.74E-01
0.050	9.40E-01	9.27E-01	9.45E-01	9.30E-01	9.30E-01	9.67E-01	9.37E-01
0.100	8.18E-01	7.74E-01	8.39E-01	7.93E-01	7.95E-01	9.06E-01	8.18E-01
0.200	5.82E-01	4.86E-01	6.12E-01	5.19E-01	5.61E-01	7.87E-01	6.06E-01
0.500	4.04E-01	3.18E-01	3.62E-01	3.59E-01	3.58E-01	7.11E-01	3.68E-01
1.000	3.66E-01	2.82E-01	2.91E-01	3.29E-01	2.94E-01	6.97E-01	2.74E-01
1.500	3.56E-01	2.69E-01	2.73E-01	3.21E-01	2.78E-01	6.96E-01	2.48E-01
2.000	3.49E-01	2.64E-01	2.63E-01	3.15E-01	2.68E-01	6.93E-01	2.34E-01
4.000	3.39E-01	2.54E-01	2.49E-01	3.08E-01	2.54E-01	6.83E-01	2.15E-01

APPENDIX E
CHORD LENGTH DISTRIBUTION THROUGH CORTICAL CAVITIES AND CORTICAL BONE IN THREE BONE SITES OF A 44 YEAR-OLD MALE

Table E.1· Chord length distribution in cortical bone.

Length (um)	Femur	Humerus & Tibia	Length (um)	Femur	Humerus & Tibia	Length (um)	Femur	Humerus & Tibia
50	1.14E-03	1.10E-03	3100	3.87E-05	3.80E-05	6600	1.33E-06	9.64E-07
100	1.52E-03	1.43E-03	3200	3.52E-05	3.42E-05	6700	1.21E-06	8.68E-07
150	1.25E-03	1.18E-03	3300	3.17E-05	3.08E-05	6800	1.10E-06	7.82E-07
200	1.28E-03	1.04E-03	3400	2.88E-05	2.77E-05	6900	9.95E-07	7.04E-07
250	1.13E-03	9.47E-04	3500	2.62E-05	2.50E-05	7000	9.03E-07	6.34E-07
300	9.61E-04	8.60E-04	3600	2.38E-05	2.25E-05	7100	8.21E-07	5.70E-07
350	8.59E-04	7.89E-04	3700	2.16E-05	2.02E-05	7200	7.45E-07	5.14E-07
400	7.68E-04	7.28E-04	3800	1.96E-05	1.82E-05	7300	6.77E-07	4.62E-07
450	7.01E-04	6.71E-04	3900	1.78E-05	1.64E-05	7400	6.15E-07	4.16E-07
500	6.48E-04	6.32E-04	4000	1.62E-05	1.48E-05	7500	5.59E-07	3.75E-07
600	5.53E-04	5.53E-04	4100	1.47E-05	1.33E-05	7600	5.07E-07	3.38E-07
700	4.86E-04	4.78E-04	4200	1.33E-05	1.20E-05	7700	4.61E-07	3.04E-07
800	4.23E-04	4.30E-04	4300	1.21E-05	1.08E-05	7800	4.19E-07	2.74E-07
900	3.59E-04	3.82E-04	4400	1.10E-05	9.71E-06	7900	3.80E-07	2.46E-07
1000	3.24E-04	3.46E-04	4500	1.00E-05	8.74E-06	8000	3.45E-07	2.22E-07
1100	2.89E-04	3.11E-04	4600	9.08E-06	7.87E-06	8100	3.14E-07	2.00E-07
1200	2.54E-04	2.81E-04	4700	8.25E-06	7.08E-06	8200	2.85E-07	1.80E-07
1300	2.29E-04	2.54E-04	4800	7.49E-06	6.38E-06	8300	2.59E-07	1.62E-07
1400	2.04E-04	2.24E-04	4900	6.81E-06	5.74E-06	8400	2.35E-07	1.46E-07
1500	1.83E-04	2.06E-04	5000	6.18E-06	5.17E-06	8500	2.14E-07	1.31E-07
1600	1.65E-04	1.84E-04	5100	5.62E-06	4.66E-06	8600	1.94E-07	1.18E-07
1700	1.55E-04	1.66E-04	5200	5.10E-06	4.19E-06	8700	1.76E-07	1.06E-07
1800	1.41E-04	1.49E-04	5300	4.63E-06	3.77E-06	8800	1.60E-07	9.58E-08
1900	1.30E-04	1.34E-04	5400	4.21E-06	3.40E-06	8900	1.45E-07	8.62E-08
2000	1.20E-04	1.21E-04	5500	3.82E-06	3.06E-06	9000	1.32E-07	7.76E-08
2100	1.09E-04	1.09E-04	5600	3.47E-06	2.75E-06	9100	1.20E-07	6.99E-08
2200	1.02E-04	9.79E-05	5700	3.15E-06	2.48E-06	9200	1.09E-07	6.29E-08
2300	9.86E-05	8.82E-05	5800	2.86E-06	2.23E-06	9300	9.90E-08	5.67E-08
2400	8.80E-05	7.94E-05	5900	2.60E-06	2.01E-06	9400	8.99E-08	5.10E-08
2500	7.75E-05	7.14E-05	6000	2.36E-06	1.81E-06	9500	8.16E-08	4.59E-08
2600	7.04E-05	6.43E-05	6100	2.15E-06	1.63E-06	9600	7.42E-08	4.14E-08
2700	6.34E-05	5.79E-05	6200	1.95E-06	1.47E-06	9700	6.74E-08	3.72E-08
2800	5.63E-05	5.21E-05	6300	1.77E-06	1.32E-06	9800	6.12E-08	3.35E-08
2900	4.93E-05	4.69E-05	6400	1.61E-06	1.19E-06	9900	5.56E-08	3.02E-08
3000	4.23E-05	4.22E-05	6500	1.46E-06	1.07E-06	10000	5.05E-08	2.72E-08

Table E.2: Chord length distribution in Haversian canals.

Length (um)	Femur	Humerus	Tibia	Length (um)	Femur	Humerus	Tibia
5	6.20E-03	7.19E-03	9.12E-03	350	1.88E-04	1.45E-04	3.11E-04
10	7.18E-03	8.86E-03	8.51E-03	360	1.73E-04	1.40E-04	2.85E-04
15	9.01E-03	1.03E-02	8.33E-03	370	1.60E-04	1.35E-04	2.62E-04
20	9.86E-03	1.28E-02	8.07E-03	380	1.47E-04	1.30E-04	2.40E-04
25	1.06E-02	1.37E-02	7.81E-03	390	1.36E-04	1.25E-04	2.20E-04
30	1.07E-02	1.39E-02	7.50E-03	400	1.25E-04	1.20E-04	2.01E-04
35	1.11E-02	1.46E-02	7.32E-03	410	1.16E-04	1.16E-04	1.84E-04
40	1.07E-02	1.34E-02	6.97E-03	420	1.07E-04	1.12E-04	1.69E-04
45	1.06E-02	1.18E-02	6.67E-03	430	9.83E-05	1.08E-04	1.55E-04
50	9.86E-03	9.96E-03	6.32E-03	440	9.06E-05	1.04E-04	1.42E-04
55	9.58E-03	8.99E-03	6.01E-03	450	8.36E-05	9.99E-05	1.30E-04
60	9.01E-03	7.54E-03	5.70E-03	460	7.70E-05	9.62E-05	1.19E-04
65	8.17E-03	6.18E-03	5.48E-03	470	7.10E-05	9.27E-05	1.09E-04
70	6.90E-03	5.18E-03	5.18E-03	480	6.55E-05	8.93E-05	1.00E-04
75	5.63E-03	4.43E-03	4.87E-03	490	6.04E-05	8.60E-05	9.17E-05
80	4.86E-03	3.95E-03	4.65E-03	500	5.57E-05	8.29E-05	8.40E-05
85	4.51E-03	3.55E-03	4.39E-03	510	5.14E-05	7.98E-05	7.70E-05
90	4.01E-03	3.11E-03	4.17E-03	520	4.74E-05	7.69E-05	7.05E-05
95	3.73E-03	2.85E-03	3.90E-03	530	4.37E-05	7.41E-05	6.46E-05
100	3.38E-03	2.59E-03	3.73E-03	540	4.03E-05	7.14E-05	5.92E-05
110	2.82E-03	2.15E-03	3.33E-03	550	3.71E-05	6.87E-05	5.43E-05
120	2.39E-03	1.84E-03	2.98E-03	560	3.42E-05	6.62E-05	4.97E-05
130	1.97E-03	1.58E-03	2.68E-03	570	3.16E-05	6.38E-05	4.56E-05
140	1.62E-03	1.32E-03	2.41E-03	580	2.91E-05	6.14E-05	4.18E-05
150	1.34E-03	1.14E-03	2.11E-03	590	2.68E-05	5.92E-05	3.83E-05
160	1.13E-03	9.21E-04	1.93E-03	600	2.48E-05	5.70E-05	3.51E-05
170	9.15E-04	7.46E-04	1.80E-03	610	2.28E-05	5.49E-05	3.21E-05
180	8.45E-04	6.58E-04	1.67E-03	620	2.11E-05	5.29E-05	2.94E-05
190	7.75E-04	5.70E-04	1.45E-03	630	1.94E-05	5.10E-05	2.70E-05
200	7.04E-04	4.82E-04	1.27E-03	640	1.79E-05	4.91E-05	2.47E-05
210	6.34E-04	3.95E-04	1.20E-03	650	1.65E-05	4.73E-05	2.27E-05
220	5.63E-04	3.07E-04	1.05E-03	660	1.52E-05	4.56E-05	2.08E-05
230	4.93E-04	2.63E-04	8.77E-04	670	1.40E-05	4.39E-05	1.90E-05
240	4.93E-04	2.19E-04	7.89E-04	680	1.29E-05	4.23E-05	1.74E-05
250	4.23E-04	1.75E-04	7.46E-04	690	1.19E-05	4.07E-05	1.60E-05
260	4.23E-04	1.75E-04	7.02E-04	700	1.10E-05	3.92E-05	1.46E-05
270	3.52E-04	1.75E-04	6.14E-04	710	1.01E-05	3.78E-05	1.34E-05
280	3.52E-04	1.75E-04	5.70E-04	720	9.36E-06	3.64E-05	1.23E-05
290	2.82E-04	1.75E-04	5.26E-04	730	8.63E-06	3.51E-05	1.13E-05
300	2.82E-04	1.75E-04	4.82E-04	740	7.96E-06	3.38E-05	1.03E-05
310	2.60E-04	1.69E-04	4.42E-04	750	7.34E-06	3.25E-05	9.46E-06
320	2.40E-04	1.62E-04	4.05E-04	760	6.76E-06	3.14E-05	8.67E-06
330	2.21E-04	1.56E-04	3.71E-04	770	6.24E-06	3.02E-05	7.94E-06
340	2.04E-04	1.51E-04	3.40E-04	780	5.75E-06	2.91E-05	7.28E-06

Table E.2: Continued.

Length (um)	Femur	Humerus	Tibia	Length (um)	Femur	Humerus	Tibia
790	5.30E-06	2.80E-05	6.67E-06	1140	3.10E-07	7.57E-06	3.13E-07
800	4.89E-06	2.70E-05	6.11E-06	1150	2.86E-07	7.30E-06	2.87E-07
810	4.51E-06	2.60E-05	5.60E-06	1160	2.64E-07	7.03E-06	2.63E-07
820	4.16E-06	2.51E-05	5.13E-06	1170	2.43E-07	6.77E-06	2.41E-07
830	3.83E-06	2.41E-05	4.70E-06	1180	2.24E-07	6.52E-06	2.21E-07
840	3.54E-06	2.32E-05	4.31E-06	1190	2.07E-07	6.28E-06	2.03E-07
850	3.26E-06	2.24E-05	3.95E-06	1200	1.91E-07	6.05E-06	1.86E-07
860	3.01E-06	2.16E-05	3.62E-06	1210	1.76E-07	5.83E-06	1.70E-07
870	2.77E-06	2.08E-05	3.32E-06	1220	1.62E-07	5.62E-06	1.56E-07
880	2.56E-06	2.00E-05	3.04E-06	1230	1.50E-07	5.41E-06	1.43E-07
890	2.36E-06	1.93E-05	2.78E-06	1240	1.38E-07	5.21E-06	1.31E-07
900	2.17E-06	1.86E-05	2.55E-06	1250	1.27E-07	5.02E-06	1.20E-07
910	2.00E-06	1.79E-05	2.34E-06	1260	1.17E-07	4.84E-06	1.10E-07
920	1.85E-06	1.72E-05	2.14E-06	1270	1.08E-07	4.66E-06	1.01E-07
930	1.70E-06	1.66E-05	1.96E-06	1280	9.97E-08	4.49E-06	9.23E-08
940	1.57E-06	1.60E-05	1.80E-06	1290	9.20E-08	4.32E-06	8.46E-08
950	1.45E-06	1.54E-05	1.65E-06	1300	8.48E-08	4.16E-06	7.75E-08
960	1.34E-06	1.48E-05	1.51E-06	1310	7.82E-08	4.01E-06	7.10E-08
970	1.23E-06	1.43E-05	1.38E-06	1320	7.21E-08	3.86E-06	6.51E-08
980	1.14E-06	1.38E-05	1.27E-06	1330	6.65E-08	3.72E-06	5.96E-08
990	1.05E-06	1.33E-05	1.16E-06	1340	6.13E-08	3.59E-06	5.46E-08
1000	9.66E-07	1.28E-05	1.07E-06	1350	5.65E-08	3.45E-06	5.01E-08
1010	8.91E-07	1.23E-05	9.76E-07	1360	5.21E-08	3.33E-06	4.59E-08
1020	8.21E-07	1.19E-05	8.94E-07	1370	4.81E-08	3.21E-06	4.20E-08
1030	7.57E-07	1.14E-05	8.19E-07	1380	4.43E-08	3.09E-06	3.85E-08
1040	6.98E-07	1.10E-05	7.51E-07	1390	4.09E-08	2.98E-06	3.53E-08
1050	6.44E-07	1.06E-05	6.88E-07	1400	3.77E-08	2.87E-06	3.23E-08
1060	5.94E-07	1.02E-05	6.31E-07	1410	3.48E-08	2.76E-06	2.96E-08
1070	5.48E-07	9.84E-06	5.78E-07	1420	3.20E-08	2.66E-06	2.72E-08
1080	5.05E-07	9.48E-06	5.29E-07	1430	2.96E-08	2.56E-06	2.49E-08
1090	4.66E-07	9.13E-06	4.85E-07	1440	2.73E-08	2.47E-06	2.28E-08
1100	4.29E-07	8.80E-06	4.45E-07	1450	2.51E-08	2.38E-06	2.09E-08
1110	3.96E-07	8.47E-06	4.07E-07	1460	2.32E-08	2.29E-06	1.92E-08
1120	3.65E-07	8.16E-06	3.73E-07	1470	2.14E-08	2.21E-06	1.75E-08
1130	3.37E-07	7.86E-06	3.42E-07	1480	1.97E-08	2.13E-06	1.61E-08

APPENDIX F
ELECTRON ABSORBED FRACTIONS OF ENERGY IN CORTICAL BONE

Table F.1: Absorbed fractions of energy for monoenergetic electrons in the CHS.

		Target = CHS		
Energy (MeV)	**Femur**	**Humerus**	**Tibia**	**Average**
0.010	9.99E-01	9.98E-01	9.99E-01	9.98E-01
0.015	9.93E-01	9.94E-01	9.96E-01	9.94E-01
0.020	9.88E-01	9.89E-01	9.92E-01	9.90E-01
0.030	9.72E-01	9.73E-01	9.81E-01	9.75E-01
0.050	9.29E-01	9.29E-01	9.51E-01	9.36E-01
0.100	7.95E-01	8.11E-01	8.47E-01	8.18E-01
0.200	5.76E-01	6.34E-01	6.42E-01	6.17E-01
0.500	3.16E-01	3.98E-01	3.58E-01	3.57E-01
1.000	1.97E-01	2.59E-01	2.27E-01	2.28E-01
1.500	8.63E-02	1.13E-01	1.05E-01	1.01E-01
2.000	7.81E-02	9.87E-02	9.43E-02	9.04E-02
4.000	6.26E-02	7.92E-02	7.72E-02	7.30E-02
		Target = CBE		
Energy (MeV)	**Femur**	**Humerus**	**Tibia**	**Average**
0.010	1.48E-03	2.13E-03	1.13E-03	1.58E-03
0.015	6.53E-03	5.71E-03	4.21E-03	5.48E-03
0.020	1.17E-02	1.11E-02	8.02E-03	1.03E-02
0.030	2.76E-02	2.67E-02	1.84E-02	2.42E-02
0.050	6.58E-02	6.60E-02	4.48E-02	5.89E-02
0.100	1.24E-01	1.10E-01	9.36E-02	1.09E-01
0.200	1.14E-01	9.18E-02	1.01E-01	1.02E-01
0.500	7.15E-02	5.92E-02	6.78E-02	6.61E-02
1.000	5.48E-02	4.70E-02	5.29E-02	5.16E-02
1.500	3.40E-02	2.99E-02	3.40E-02	3.26E-02
2.000	3.19E-02	2.82E-02	3.21E-02	3.07E-02
4.000	2.85E-02	2.52E-02	2.86E-02	2.75E-02
		Target = CBV		
Energy (MeV)	**Femur**	**Humerus**	**Tibia**	**Average**
0.010	3.62E-05	1.79E-05	1.85E-05	2.42E-05
0.015	2.31E-04	9.97E-05	1.44E-04	1.58E-04
0.020	2.85E-04	1.66E-04	1.90E-04	2.13E-04
0.030	7.56E-04	5.71E-04	4.59E-04	5.95E-04
0.050	4.96E-03	5.03E-03	4.50E-03	4.83E-03
0.100	8.06E-02	7.90E-02	5.91E-02	7.29E-02
0.200	3.10E-01	2.74E-01	2.56E-01	2.80E-01
0.500	6.12E-01	5.41E-01	5.72E-01	5.75E-01
1.000	7.45E-01	6.90E-01	7.18E-01	7.18E-01
1.500	8.74E-01	8.52E-01	8.56E-01	8.61E-01
2.000	8.83E-01	8.65E-01	8.66E-01	8.71E-01
4.000	8.91E-01	8.79E-01	8.77E-01	8.82E-01

Table F.2: Absorbed fractions of energy for monoenergetic electrons in the CBE.

Target = CHS

Energy (MeV)	Femur	Humerus	Tibia	Average
0.010	2.68E-02	2.66E-02	2.73E-02	2.69E-02
0.015	5.35E-02	5.07E-02	5.70E-02	5.37E-02
0.020	9.27E-02	8.56E-02	1.00E-01	9.28E-02
0.030	1.56E-01	1.45E-01	1.65E-01	1.55E-01
0.050	1.76E-01	1.49E-01	2.00E-01	1.75E-01
0.100	1.16E-01	9.93E-02	1.57E-01	1.24E-01
0.200	6.91E-02	6.46E-02	9.59E-02	7.65E-02
0.500	4.21E-02	4.07E-02	5.65E-02	4.64E-02
1.000	3.36E-02	3.42E-02	4.63E-02	3.80E-02
1.500	3.01E-02	3.02E-02	4.17E-02	3.40E-02
2.000	2.86E-02	2.92E-02	4.01E-02	3.26E-02
4.000	2.68E-02	2.72E-02	3.83E-02	3.08E-02

Target = CBE

Energy (MeV)	Femur	Humerus	Tibia	Average
0.010	9.23E-01	9.21E-01	9.21E-01	9.21E-01
0.015	8.38E-01	8.37E-01	8.37E-01	8.37E-01
0.020	7.23E-01	7.31E-01	7.25E-01	7.26E-01
0.030	5.08E-01	5.07E-01	5.03E-01	5.06E-01
0.050	2.71E-01	2.70E-01	2.62E-01	2.68E-01
0.100	1.10E-01	1.08E-01	1.10E-01	1.09E-01
0.200	5.69E-02	5.31E-02	5.82E-02	5.60E-02
0.500	3.45E-02	3.09E-02	3.49E-02	3.34E-02
1.000	2.83E-02	2.56E-02	2.86E-02	2.75E-02
1.500	2.56E-02	2.31E-02	2.63E-02	2.50E-02
2.000	2.43E-02	2.22E-02	2.48E-02	2.38E-02
4.000	2.25E-02	2.07E-02	2.35E-02	2.22E-02

Target = CBV

Energy (MeV)	Femur	Humerus	Tibia	Average
0.010	5.08E-02	5.24E-02	5.19E-02	5.17E-02
0.015	1.09E-01	1.13E-01	1.06E-01	1.09E-01
0.020	1.85E-01	1.83E-01	1.75E-01	1.81E-01
0.030	3.36E-01	3.48E-01	3.33E-01	3.39E-01
0.050	5.53E-01	5.82E-01	5.38E-01	5.58E-01
0.100	7.74E-01	7.93E-01	7.33E-01	7.66E-01
0.200	8.73E-01	8.82E-01	8.46E-01	8.67E-01
0.500	9.22E-01	9.27E-01	9.07E-01	9.18E-01
1.000	9.35E-01	9.37E-01	9.22E-01	9.31E-01
1.500	9.38E-01	9.41E-01	9.26E-01	9.35E-01
2.000	9.40E-01	9.41E-01	9.27E-01	9.36E-01
4.000	9.32E-01	9.33E-01	9.20E-01	9.28E-01

Table F.3: Absorbed fractions of energy for monoenergetic electrons in the CBV.

		Target = CHS		
Energy (MeV)	**Femur**	**Humerus**	**Tibia**	**Average**
0.010	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.015	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.020	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.030	0.00E+00	0.00E+00	4.11E-06	1.37E-06
0.050	1.60E-05	4.71E-05	2.09E-05	2.80E-05
0.100	1.77E-03	1.37E-03	1.93E-03	1.69E-03
0.200	7.66E-03	6.12E-03	9.04E-03	7.61E-03
0.500	1.55E-02	1.35E-02	2.10E-02	1.67E-02
1.000	2.42E-02	2.41E-02	3.45E-02	2.76E-02
1.500	2.43E-02	2.46E-02	3.40E-02	2.76E-02
2.000	2.37E-02	2.39E-02	3.28E-02	2.68E-02
4.000	2.30E-02	2.36E-02	3.27E-02	2.64E-02

		Target = CBE		
Energy (MeV)	**Femur**	**Humerus**	**Tibia**	**Average**
0.010	4.32E-05	3.60E-05	6.53E-05	4.82E-05
0.015	2.68E-04	4.32E-05	6.68E-05	1.26E-04
0.020	2.79E-04	2.71E-04	4.28E-04	3.26E-04
0.030	7.29E-04	8.95E-04	9.24E-04	8.49E-04
0.050	2.35E-03	2.54E-03	2.46E-03	2.45E-03
0.100	6.57E-03	6.47E-03	6.73E-03	6.59E-03
0.200	1.18E-02	1.22E-02	1.21E-02	1.21E-02
0.500	1.63E-02	1.53E-02	1.60E-02	1.58E-02
1.000	2.09E-02	1.94E-02	2.17E-02	2.07E-02
1.500	2.06E-02	1.90E-02	2.16E-02	2.04E-02
2.000	2.01E-02	1.88E-02	2.09E-02	1.99E-02
4.000	1.99E-02	1.84E-02	2.09E-02	1.97E-02

		Target = CBV		
Energy (MeV)	**Femur**	**Humerus**	**Tibia**	**Average**
0.010	1.00E+00	1.00E+00	1.00E+00	1.00E+00
0.015	1.00E+00	1.00E+00	1.00E+00	1.00E+00
0.020	1.00E+00	1.00E+00	1.00E+00	1.00E+00
0.030	9.99E-01	9.99E-01	9.99E-01	9.99E-01
0.050	9.98E-01	9.97E-01	9.98E-01	9.98E-01
0.100	9.92E-01	9.92E-01	9.91E-01	9.92E-01
0.200	9.80E-01	9.81E-01	9.79E-01	9.80E-01
0.500	9.67E-01	9.70E-01	9.61E-01	9.66E-01
1.000	9.51E-01	9.53E-01	9.40E-01	9.48E-01
1.500	9.50E-01	9.50E-01	9.39E-01	9.46E-01
2.000	9.48E-01	9.49E-01	9.39E-01	9.45E-01
4.000	9.39E-01	9.39E-01	9.28E-01	9.35E-01

APPENDIX G
BONE SITE-SPECIFIC RADIONUCLIDE S VALUES IN TRABECULAR BONE

Table G.1: Table of S values (mGy MBq^{-1} s^{-1}) to the TMS for 22 different bone sites for a source located in the TMS. This table is also equivalent to S values to the TAM for a source in the TMS.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.52E-04	3.93E-05	1.32E-04	6.55E-05	1.96E-04	7.34E-05	9.84E-05	4.78E-05	6.00E-05	9.49E-05
Mandible	1.60E-03	4.15E-04	1.40E-03	6.91E-04	2.07E-03	7.75E-04	1.04E-03	5.05E-04	6.33E-04	1.00E-03
Cervical Vert.	1.14E-03	1.71E-04	9.65E-04	3.69E-04	1.51E-03	3.34E-04	5.22E-04	2.21E-04	2.98E-04	6.08E-04
Thoracic Vert.	2.98E-04	4.26E-05	2.53E-04	9.47E-05	3.98E-04	8.36E-05	1.33E-04	5.54E-05	7.56E-05	1.58E-04
Lumbar Vert.	4.15E-04	5.65E-05	3.51E-04	1.29E-04	5.53E-04	1.11E-04	1.81E-04	7.41E-05	1.02E-04	2.17E-04
Sternum	1.81E-03	2.37E-04	1.53E-03	5.56E-04	2.41E-03	4.70E-04	7.74E-04	3.13E-04	4.33E-04	9.43E-04
Ribs	3.40E-04	4.45E-05	2.88E-04	1.05E-04	4.54E-04	8.84E-05	1.46E-04	5.89E-05	8.15E-05	1.77E-04
Scapulae	9.15E-04	1.29E-04	7.75E-04	2.88E-04	1.22E-03	2.54E-04	4.06E-04	1.68E-04	2.29E-04	4.82E-04
Clavicles	2.86E-03	4.05E-04	2.42E-03	8.99E-04	3.82E-03	7.94E-04	1.27E-03	5.26E-04	7.17E-04	1.51E-03
Os Coxae	2.09E-04	2.96E-05	1.77E-04	6.58E-05	2.80E-04	5.81E-05	9.29E-05	3.85E-05	5.25E-05	1.10E-04
Sacrum	3.70E-04	5.24E-05	3.13E-04	1.16E-04	4.94E-04	1.03E-04	1.64E-04	6.81E-05	9.28E-05	1.95E-04
Humerii, upper half	1.25E-03	1.71E-04	1.05E-03	3.86E-04	1.67E-03	3.36E-04	5.43E-04	2.23E-04	3.06E-04	6.51E-04
Humerii, lower half	1.26E-03	1.73E-04	1.07E-03	3.93E-04	1.69E-03	3.41E-04	5.51E-04	2.26E-04	3.10E-04	6.61E-04
Radii	2.89E-03	3.95E-04	2.45E-03	8.99E-04	3.86E-03	7.80E-04	1.26E-03	5.18E-04	7.10E-04	1.51E-03
Ulna	2.81E-03	3.85E-04	2.38E-03	8.76E-04	3.76E-03	7.59E-04	1.23E-03	5.04E-04	6.92E-04	1.47E-03
Hands	8.49E-04	1.16E-04	7.18E-04	2.64E-04	1.13E-03	2.29E-04	3.70E-04	1.52E-04	2.09E-04	4.45E-04
Femura, upper half	5.35E-04	7.32E-05	4.52E-04	1.66E-04	7.15E-04	1.44E-04	2.33E-04	9.57E-05	1.31E-04	2.79E-04
Femura, lower half	5.42E-04	7.40E-05	4.58E-04	1.69E-04	7.24E-04	1.46E-04	2.36E-04	9.70E-05	1.33E-04	2.84E-04
Patella	2.84E-03	3.88E-04	2.41E-03	8.84E-04	3.80E-03	7.67E-04	1.24E-03	5.09E-04	6.98E-04	1.49E-03
Tibia	4.26E-04	5.82E-05	3.61E-04	1.33E-04	5.70E-04	1.15E-04	1.86E-04	7.63E-05	1.05E-04	2.23E-04
Fibula	3.02E-03	4.13E-04	2.56E-03	9.41E-04	4.04E-03	8.16E-04	1.32E-03	5.42E-04	7.43E-04	1.58E-03
Feet	2.76E-04	3.78E-05	2.34E-04	8.60E-05	3.69E-04	7.46E-05	1.21E-04	4.95E-05	6.79E-05	1.45E-04

Table G.2: Table of S values (mGy MBq^{-1} s^{-1}) to the TBE for 22 different bone sites for a source located in the TMS. This table is also equivalent to S values to the TBE for a source in the TAM.

Skeletal Region	**^{32}P**	**^{33}P**	**^{89}Sr**	**^{90}Sr**	**^{90}Y**	**^{117m}Sn**	**^{153}Sm**	**^{169}Er**	**^{177}Lu**	**^{186}Re**
Cranium	3.05E-03	3.64E-04	2.58E-03	9.07E-04	4.09E-03	7.51E-04	1.21E-03	4.75E-04	6.89E-04	1.55E-03
Mandible	2.75E-02	3.27E-03	2.32E-02	8.16E-03	3.68E-02	6.76E-03	1.09E-02	4.28E-03	6.20E-03	1.40E-02
Cervical Vert.	9.24E-04	5.92E-05	7.67E-04	2.13E-04	1.27E-03	1.28E-04	2.80E-04	8.71E-05	1.40E-04	4.21E-04
Thoracic Vert.	3.39E-04	2.09E-05	2.81E-04	7.71E-05	4.66E-04	4.55E-05	1.01E-04	3.12E-05	5.04E-05	1.54E-04
Lumbar Vert.	3.88E-04	2.28E-05	3.21E-04	8.69E-05	5.33E-04	5.01E-05	1.13E-04	3.46E-05	5.63E-05	1.74E-04
Sternum	1.86E-02	1.05E-03	1.53E-02	4.08E-03	2.56E-02	2.30E-03	5.33E-03	1.60E-03	2.62E-03	8.24E-03
Ribs	1.86E-03	1.05E-04	1.53E-03	4.08E-04	2.56E-03	2.30E-04	5.33E-04	1.60E-04	2.62E-04	8.24E-04
Scapulae	5.57E-03	3.45E-04	4.62E-03	1.28E-03	7.62E-03	7.56E-04	1.67E-03	5.18E-04	8.38E-04	2.54E-03
Clavicles	1.86E-02	1.15E-03	1.54E-02	4.28E-03	2.54E-02	2.52E-03	5.58E-03	1.73E-03	2.79E-03	8.46E-03
Os Coxae	1.33E-03	8.22E-05	1.10E-03	3.05E-04	1.81E-03	1.80E-04	3.98E-04	1.23E-04	2.00E-04	6.04E-04
Sacrum	1.99E-03	1.23E-04	1.65E-03	4.58E-04	2.72E-03	2.70E-04	5.97E-04	1.85E-04	2.99E-04	9.06E-04
Humerii, upper half	2.77E-03	1.60E-04	2.29E-03	6.20E-04	3.80E-03	3.52E-04	8.11E-04	2.43E-04	3.99E-04	1.25E-03
Humerii, lower half	2.53E-03	1.43E-04	2.09E-03	5.56E-04	3.47E-03	3.15E-04	7.30E-04	2.17E-04	3.57E-04	1.13E-03
Radii	2.84E-03	1.61E-04	2.35E-03	6.26E-04	3.91E-03	3.54E-04	8.21E-04	2.44E-04	4.01E-04	1.27E-03
Ulna	2.27E-03	1.29E-04	1.88E-03	5.00E-04	3.12E-03	2.83E-04	6.57E-04	1.95E-04	3.21E-04	1.02E-03
Hands	6.50E-03	3.69E-04	5.37E-03	1.43E-03	8.93E-03	8.09E-04	1.88E-03	5.58E-04	9.18E-04	2.91E-03
Femura, upper half	4.45E-04	2.58E-05	3.69E-04	9.96E-05	6.11E-04	5.66E-05	1.30E-04	3.90E-05	6.41E-05	2.01E-04
Femura, lower half	4.06E-04	2.30E-05	3.36E-04	8.94E-05	5.58E-04	5.06E-05	1.17E-04	3.49E-05	5.73E-05	1.82E-04
Patella	7.58E-03	4.30E-04	6.27E-03	1.67E-03	1.04E-02	9.44E-04	2.19E-03	6.51E-04	1.07E-03	3.39E-03
Tibia	4.55E-04	2.58E-05	3.76E-04	1.00E-04	6.25E-04	5.66E-05	1.31E-04	3.91E-05	6.42E-05	2.03E-04
Fibula	3.50E-03	1.99E-04	2.89E-03	7.70E-04	4.81E-03	4.36E-04	1.01E-03	3.00E-04	4.94E-04	1.57E-03
Feet	3.03E-03	1.72E-04	2.51E-03	6.67E-04	4.17E-03	3.78E-04	8.75E-04	2.60E-04	4.28E-04	1.36E-03

Table G.3: Table of S values (mGy MBq^{-1} s^{-1}) to the TBV for 22 different bone sites for a source located in the TMS. This table is also equivalent to S values to the TBV for a source in the TAM.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.72E-03	7.05E-05	1.42E-03	3.65E-04	2.37E-03	1.71E-04	4.61E-04	1.24E-04	2.17E-04	7.57E-04
Mandible	1.69E-02	6.94E-04	1.40E-02	3.59E-03	2.34E-02	1.69E-03	4.54E-03	1.22E-03	2.14E-03	7.45E-03
Cervical Vert.	5.77E-04	2.18E-05	4.75E-04	1.18E-04	7.99E-04	5.31E-05	1.50E-04	3.90E-05	6.93E-05	2.49E-04
Thoracic Vert.	1.95E-04	7.29E-06	1.60E-04	3.93E-05	2.71E-04	1.78E-05	5.00E-05	1.30E-05	2.31E-05	8.36E-05
Lumbar Vert.	2.19E-04	8.09E-06	1.80E-04	4.34E-05	3.06E-04	1.97E-05	5.53E-05	1.44E-05	2.55E-05	9.30E-05
Sternum	1.20E-02	3.86E-04	9.79E-03	2.19E-03	1.69E-02	9.39E-04	2.83E-03	6.95E-04	1.26E-03	4.90E-03
Ribs	1.03E-03	3.32E-05	8.40E-04	1.88E-04	1.45E-03	8.06E-05	2.43E-04	5.97E-05	1.09E-04	4.21E-04
Scapulae	2.93E-03	1.17E-04	2.41E-03	6.11E-04	4.06E-03	2.84E-04	7.73E-04	2.07E-04	3.63E-04	1.27E-03
Clavicles	9.15E-03	3.64E-04	7.54E-03	1.91E-03	1.27E-02	8.87E-04	2.41E-03	6.45E-04	1.13E-03	3.98E-03
Os Coxae	6.60E-04	2.63E-05	5.44E-04	1.38E-04	9.14E-04	6.41E-05	1.74E-04	4.66E-05	8.18E-05	2.87E-04
Sacrum	1.15E-03	4.58E-05	9.49E-04	2.40E-04	1.59E-03	1.12E-04	3.04E-04	8.12E-05	1.43E-04	5.01E-04
Humerii, upper half	1.41E-03	5.47E-05	1.16E-03	2.92E-04	1.95E-03	1.34E-04	3.69E-04	9.77E-05	1.73E-04	6.12E-04
Humerii, lower half	1.38E-03	4.93E-05	1.13E-03	2.74E-04	1.91E-03	1.20E-04	3.49E-04	8.91E-05	1.60E-04	5.87E-04
Radii	1.56E-03	5.59E-05	1.28E-03	3.10E-04	2.17E-03	1.36E-04	3.96E-04	1.01E-04	1.81E-04	6.65E-04
Ulna	1.24E-03	4.44E-05	1.02E-03	2.46E-04	1.72E-03	1.08E-04	3.14E-04	8.01E-05	1.44E-04	5.28E-04
Hands	3.57E-03	1.28E-04	2.93E-03	7.11E-04	4.96E-03	3.13E-04	9.06E-04	2.31E-04	4.15E-04	1.53E-03
Femura, upper half	2.19E-04	8.50E-06	1.80E-04	4.53E-05	3.03E-04	2.08E-05	5.74E-05	1.52E-05	2.68E-05	9.51E-05
Femura, lower half	2.14E-04	7.66E-06	1.75E-04	4.25E-05	2.97E-04	1.87E-05	5.42E-05	1.38E-05	2.48E-05	9.12E-05
Patella	3.90E-03	1.40E-04	3.20E-03	7.76E-04	5.41E-03	3.41E-04	9.89E-04	2.52E-04	4.53E-04	1.66E-03
Tibia	2.47E-04	8.87E-06	2.03E-04	4.92E-05	3.44E-04	2.17E-05	6.28E-05	1.60E-05	2.87E-05	1.06E-04
Fibula	1.85E-03	6.64E-05	1.52E-03	3.68E-04	2.57E-03	1.62E-04	4.70E-04	1.20E-04	2.15E-04	7.90E-04
Feet	1.67E-03	5.99E-05	1.37E-03	3.32E-04	2.32E-03	1.46E-04	4.24E-04	1.08E-04	1.94E-04	7.13E-04

Table G.4: Table of S values (mGy MBq^{-1} s^{-1}) to the TMS for 22 different bone sites for a source located in the TBE. This table is also equivalent to S values to the TAM for a source in the TBE.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.33E-04	1.70E-05	1.13E-04	4.04E-05	1.78E-04	3.45E-05	5.44E-05	2.18E-05	3.13E-05	6.86E-05
Mandible	1.41E-03	1.80E-04	1.19E-03	4.27E-04	1.88E-03	3.64E-04	5.74E-04	2.31E-04	3.30E-04	7.24E-04
Cervical Vert.	1.05E-03	8.14E-05	8.71E-04	2.59E-04	1.43E-03	1.72E-04	3.41E-04	1.15E-04	1.78E-04	4.90E-04
Thoracic Vert.	2.74E-04	2.07E-05	2.28E-04	6.73E-05	3.75E-04	4.39E-05	8.84E-05	2.95E-05	4.60E-05	1.28E-04
Lumbar Vert.	3.80E-04	2.79E-05	3.16E-04	9.27E-05	5.20E-04	5.97E-05	1.21E-04	4.03E-05	6.30E-05	1.77E-04
Sternum	1.65E-03	1.18E-04	1.37E-03	3.98E-04	2.26E-03	2.54E-04	5.21E-04	1.72E-04	2.70E-04	7.62E-04
Ribs	3.10E-04	2.23E-05	2.57E-04	7.49E-05	4.25E-04	4.78E-05	9.79E-05	3.23E-05	5.07E-05	1.43E-04
Scapulae	8.53E-04	6.53E-05	7.11E-04	2.12E-04	1.16E-03	1.39E-04	2.78E-04	9.33E-05	1.45E-04	4.01E-04
Clavicles	2.67E-03	2.04E-04	2.22E-03	6.63E-04	3.64E-03	4.35E-04	8.69E-04	2.92E-04	4.54E-04	1.25E-03
Os Coxae	1.95E-04	1.49E-05	1.63E-04	4.86E-05	2.66E-04	3.18E-05	6.37E-05	2.14E-05	3.33E-05	9.18E-05
Sacrum	3.45E-04	2.64E-05	2.88E-04	8.59E-05	4.71E-04	5.63E-05	1.13E-04	3.78E-05	5.88E-05	1.62E-04
Humerii, upper half	1.16E-03	8.53E-05	9.62E-04	2.82E-04	1.58E-03	1.82E-04	3.70E-04	1.23E-04	1.92E-04	5.38E-04
Humerii, lower half	1.17E-03	8.52E-05	9.69E-04	2.82E-04	1.60E-03	1.82E-04	3.71E-04	1.22E-04	1.92E-04	5.41E-04
Radii	2.67E-03	1.95E-04	2.22E-03	6.46E-04	3.65E-03	4.16E-04	8.49E-04	2.80E-04	4.39E-04	1.24E-03
Ulna	2.60E-03	1.90E-04	2.16E-03	6.29E-04	3.56E-03	4.05E-04	8.26E-04	2.73E-04	4.27E-04	1.20E-03
Hands	7.83E-04	5.73E-05	6.51E-04	1.90E-04	1.07E-03	1.22E-04	2.49E-04	8.22E-05	1.29E-04	3.63E-04
Femura, upper half	4.96E-04	3.66E-05	4.13E-04	1.21E-04	6.79E-04	7.79E-05	1.59E-04	5.26E-05	8.23E-05	2.31E-04
Femura, lower half	5.00E-04	3.66E-05	4.16E-04	1.21E-04	6.84E-04	7.79E-05	1.59E-04	5.25E-05	8.22E-05	2.32E-04
Patella	2.62E-03	1.92E-04	2.18E-03	6.35E-04	3.59E-03	4.09E-04	8.35E-04	2.75E-04	4.31E-04	1.22E-03
Tibia	3.93E-04	2.88E-05	3.27E-04	9.52E-05	5.39E-04	6.13E-05	1.25E-04	4.13E-05	6.47E-05	1.82E-04
Fibula	2.79E-03	2.04E-04	2.32E-03	6.76E-04	3.82E-03	4.35E-04	8.88E-04	2.93E-04	4.59E-04	1.29E-03
Feet	2.55E-04	1.87E-05	2.12E-04	6.17E-05	3.49E-04	3.97E-05	8.11E-05	2.68E-05	4.19E-05	1.18E-04

Table G.5: Table of S values (mGy MBq^{-1} s^{-1}) to the TBE for 22 different bone sites for a source located in the TBE.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	3.36E-03	1.21E-03	2.93E-03	1.46E-03	4.38E-03	1.78E-03	2.95E-03	1.51E-03	1.57E-03	2.18E-03
Mandible	3.03E-02	1.09E-02	2.64E-02	1.31E-02	3.94E-02	1.61E-02	2.65E-02	1.36E-02	1.41E-02	1.96E-02
Cervical Vert.	1.09E-03	3.52E-04	9.46E-04	4.56E-04	1.42E-03	5.23E-04	8.93E-04	4.50E-04	4.72E-04	6.87E-04
Thoracic Vert.	4.13E-04	1.40E-04	3.60E-04	1.80E-04	5.35E-04	2.09E-04	3.52E-04	1.79E-04	1.87E-04	2.67E-04
Lumbar Vert.	4.90E-04	1.74E-04	4.29E-04	2.23E-04	6.30E-04	2.62E-04	4.34E-04	2.22E-04	2.33E-04	3.25E-04
Sternum	2.55E-02	1.07E-02	2.27E-02	1.29E-02	3.22E-02	1.60E-02	2.57E-02	1.35E-02	1.39E-02	1.81E-02
Ribs	2.55E-03	1.07E-03	2.27E-03	1.29E-03	3.22E-03	1.60E-03	2.57E-03	1.35E-03	1.39E-03	1.81E-03
Scapulae	6.56E-03	2.13E-03	5.70E-03	2.77E-03	8.54E-03	3.18E-03	5.39E-03	2.72E-03	2.86E-03	4.15E-03
Clavicles	2.19E-02	7.09E-03	1.90E-02	9.23E-03	2.85E-02	1.06E-02	1.80E-02	9.05E-03	9.53E-03	1.38E-02
Os Coxae	1.56E-03	5.06E-04	1.36E-03	6.59E-04	2.03E-03	7.57E-04	1.28E-03	6.47E-04	6.81E-04	9.89E-04
Sacrum	2.34E-03	7.60E-04	2.03E-03	9.89E-04	3.05E-03	1.14E-03	1.92E-03	9.70E-04	1.02E-03	1.48E-03
Humerii, upper half	3.38E-03	1.15E-03	2.94E-03	1.46E-03	4.37E-03	1.70E-03	2.89E-03	1.47E-03	1.53E-03	2.18E-03
Humerii, lower half	3.14E-03	1.14E-03	2.75E-03	1.42E-03	4.04E-03	1.68E-03	2.83E-03	1.45E-03	1.50E-03	2.08E-03
Radii	3.53E-03	1.28E-03	3.09E-03	1.59E-03	4.55E-03	1.89E-03	3.18E-03	1.63E-03	1.69E-03	2.34E-03
Ulna	2.82E-03	1.03E-03	2.47E-03	1.27E-03	3.64E-03	1.52E-03	2.55E-03	1.31E-03	1.35E-03	1.87E-03
Hands	8.07E-03	2.93E-03	7.06E-03	3.64E-03	1.04E-02	4.33E-03	7.27E-03	3.73E-03	3.86E-03	5.34E-03
Femura, upper half	5.43E-04	1.84E-04	4.73E-04	2.35E-04	7.03E-04	2.73E-04	4.64E-04	2.36E-04	2.46E-04	3.50E-04
Femura, lower half	5.04E-04	1.83E-04	4.41E-04	2.27E-04	6.50E-04	2.71E-04	4.55E-04	2.33E-04	2.41E-04	3.34E-04
Patella	9.41E-03	3.42E-03	8.24E-03	4.25E-03	1.21E-02	5.05E-03	8.49E-03	4.36E-03	4.51E-03	6.23E-03
Tibia	5.65E-04	2.05E-04	4.94E-04	2.55E-04	7.28E-04	3.03E-04	5.09E-04	2.61E-04	2.70E-04	3.74E-04
Fibula	4.34E-03	1.58E-03	3.80E-03	1.96E-03	5.60E-03	2.33E-03	3.92E-03	2.01E-03	2.08E-03	2.87E-03
Feet	3.77E-03	1.37E-03	3.29E-03	1.70E-03	4.85E-03	2.02E-03	3.39E-03	1.74E-03	1.80E-03	2.49E-03

Table G.6: Table of S values (mGy MBq^{-1} s^{-1}) to the TBV for 22 different bone sites for a source located in the TBE.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.81E-03	1.54E-04	1.51E-03	4.75E-04	2.46E-03	3.31E-04	6.19E-04	2.17E-04	3.33E-04	8.70E-04
Mandible	1.78E-02	1.52E-03	1.49E-02	4.68E-03	2.42E-02	3.25E-03	6.09E-03	2.14E-03	3.27E-03	8.56E-03
Cervical Vert.	6.56E-04	8.68E-05	5.57E-04	2.10E-04	8.73E-04	1.81E-04	2.76E-04	1.13E-04	1.62E-04	3.46E-04
Thoracic Vert.	2.29E-04	3.28E-05	1.95E-04	7.58E-05	3.04E-04	6.76E-05	1.01E-04	4.20E-05	5.96E-05	1.23E-04
Lumbar Vert.	2.69E-04	4.23E-05	2.30E-04	9.29E-05	3.54E-04	8.64E-05	1.24E-04	5.33E-05	7.47E-05	1.48E-04
Sternum	1.59E-02	2.76E-03	1.37E-02	5.82E-03	2.06E-02	5.59E-03	7.82E-03	3.43E-03	4.76E-03	9.07E-03
Ribs	1.37E-03	2.37E-04	1.17E-03	5.00E-04	1.77E-03	4.80E-04	6.72E-04	2.95E-04	4.09E-04	7.78E-04
Scapulae	3.35E-03	4.84E-04	2.85E-03	1.10E-03	4.45E-03	9.94E-04	1.47E-03	6.17E-04	8.72E-04	1.79E-03
Clavicles	1.05E-02	1.51E-03	8.88E-03	3.44E-03	1.39E-02	3.10E-03	4.58E-03	1.92E-03	2.72E-03	5.59E-03
Os Coxae	7.55E-04	1.09E-04	6.41E-04	2.48E-04	1.00E-03	2.24E-04	3.31E-04	1.39E-04	1.96E-04	4.04E-04
Sacrum	1.32E-03	1.90E-04	1.12E-03	4.33E-04	1.75E-03	3.91E-04	5.77E-04	2.42E-04	3.43E-04	7.05E-04
Humerii, upper half	1.67E-03	2.66E-04	1.43E-03	5.84E-04	2.20E-03	5.46E-04	7.78E-04	3.36E-04	4.70E-04	9.25E-04
Humerii, lower half	1.67E-03	2.67E-04	1.43E-03	5.89E-04	2.19E-03	5.48E-04	7.83E-04	3.39E-04	4.74E-04	9.27E-04
Radii	1.89E-03	3.03E-04	1.62E-03	6.68E-04	2.48E-03	6.21E-04	8.87E-04	3.84E-04	5.37E-04	1.05E-03
Ulna	1.50E-03	2.40E-04	1.28E-03	5.30E-04	1.96E-03	4.93E-04	7.04E-04	3.04E-04	4.26E-04	8.33E-04
Hands	4.33E-03	6.94E-04	3.70E-03	1.53E-03	5.68E-03	1.42E-03	2.03E-03	8.80E-04	1.23E-03	2.41E-03
Femura, upper half	2.60E-04	4.14E-05	2.22E-04	9.07E-05	3.42E-04	8.49E-05	1.21E-04	5.22E-05	7.30E-05	1.44E-04
Femura, lower half	2.59E-04	4.15E-05	2.21E-04	9.16E-05	3.39E-04	8.52E-05	1.22E-04	5.26E-05	7.36E-05	1.44E-04
Patella	4.72E-03	7.57E-04	4.04E-03	1.67E-03	6.19E-03	1.55E-03	2.22E-03	9.59E-04	1.34E-03	2.63E-03
Tibia	2.99E-04	4.80E-05	2.56E-04	1.06E-04	3.93E-04	9.86E-05	1.41E-04	6.09E-05	8.52E-05	1.67E-04
Fibula	2.24E-03	3.59E-04	1.92E-03	7.93E-04	2.94E-03	7.38E-04	1.05E-03	4.56E-04	6.38E-04	1.25E-03
Feet	2.02E-03	3.24E-04	1.73E-03	7.16E-04	2.65E-03	6.66E-04	9.50E-04	4.11E-04	5.75E-04	1.13E-03

Table G.7: Table of S values (mGy MBq^{-1} s^{-1}) to the TMS for 22 different bone sites for a source located in the TBV. This table is also equivalent to S values to the TAM for a source in the TBV.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.22E-04	4.84E-06	1.01E-04	2.58E-05	1.68E-04	1.18E-05	3.26E-05	8.64E-06	1.52E-05	5.37E-05
Mandible	1.29E-03	5.11E-05	1.07E-03	2.72E-04	1.77E-03	1.25E-04	3.44E-04	9.12E-05	1.61E-04	5.67E-04
Cervical Vert.	9.93E-04	3.60E-05	8.17E-04	2.00E-04	1.38E-03	8.80E-05	2.55E-04	6.51E-05	1.17E-04	4.27E-04
Thoracic Vert.	2.58E-04	9.18E-06	2.11E-04	5.09E-05	3.59E-04	2.24E-05	6.49E-05	1.65E-05	2.97E-05	1.10E-04
Lumbar Vert.	3.54E-04	1.24E-05	2.90E-04	6.87E-05	4.95E-04	3.03E-05	8.79E-05	2.23E-05	4.00E-05	1.49E-04
Sternum	1.49E-03	4.57E-05	1.21E-03	2.67E-04	2.11E-03	1.11E-04	3.46E-04	8.31E-05	1.53E-04	6.03E-04
Ribs	2.79E-04	8.60E-06	2.28E-04	5.02E-05	3.96E-04	2.09E-05	6.50E-05	1.56E-05	2.87E-05	1.13E-04
Scapulae	8.09E-04	3.05E-05	6.66E-04	1.65E-04	1.12E-03	7.44E-05	2.09E-04	5.46E-05	9.70E-05	3.49E-04
Clavicles	2.53E-03	9.52E-05	2.08E-03	5.15E-04	3.51E-03	2.33E-04	6.54E-04	1.71E-04	3.03E-04	1.09E-03
Os Coxae	1.85E-04	6.97E-06	1.52E-04	3.77E-05	2.57E-04	1.70E-05	4.79E-05	1.25E-05	2.22E-05	7.98E-05
Sacrum	3.27E-04	1.23E-05	2.69E-04	6.67E-05	4.54E-04	3.01E-05	8.46E-05	2.21E-05	3.92E-05	1.41E-04
Humerii, upper half	1.10E-03	4.14E-05	9.09E-04	2.25E-04	1.53E-03	1.01E-04	2.86E-04	7.46E-05	1.33E-04	4.76E-04
Humerii, lower half	1.10E-03	3.80E-05	9.03E-04	2.16E-04	1.53E-03	9.30E-05	2.75E-04	6.92E-05	1.25E-04	4.66E-04
Radii	2.52E-03	8.71E-05	2.07E-03	4.93E-04	3.51E-03	2.13E-04	6.30E-04	1.59E-04	2.86E-04	1.07E-03
Ulna	2.45E-03	8.48E-05	2.01E-03	4.80E-04	3.41E-03	2.07E-04	6.14E-04	1.54E-04	2.79E-04	1.04E-03
Hands	7.39E-04	2.56E-05	6.07E-04	1.45E-04	1.03E-03	6.25E-05	1.85E-04	4.66E-05	8.40E-05	3.14E-04
Femura, upper half	4.74E-04	1.78E-05	3.90E-04	9.67E-05	6.57E-04	4.34E-05	1.23E-04	3.20E-05	5.68E-05	2.04E-04
Femura, lower half	4.72E-04	1.63E-05	3.87E-04	9.25E-05	6.57E-04	3.99E-05	1.18E-04	2.97E-05	5.36E-05	2.00E-04
Patella	2.47E-03	8.56E-05	2.03E-03	4.85E-04	3.45E-03	2.09E-04	6.20E-04	1.56E-04	2.81E-04	1.05E-03
Tibia	3.71E-04	1.28E-05	3.05E-04	7.28E-05	5.17E-04	3.14E-05	9.29E-05	2.34E-05	4.22E-05	1.57E-04
Fibula	2.63E-03	9.11E-05	2.16E-03	5.16E-04	3.67E-03	2.23E-04	6.60E-04	1.66E-04	2.99E-04	1.12E-03
Feet	2.41E-04	8.33E-06	1.98E-04	4.72E-05	3.35E-04	2.03E-05	6.03E-05	1.52E-05	2.74E-05	1.02E-04

Table G.8: Table of S values (mGy MBq^{-1} s^{-1}) to the TBE for 22 different bone sites for a source located in the TBV.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	2.96E-03	2.20E-04	2.48E-03	7.54E-04	4.01E-03	4.85E-04	9.70E-04	3.24E-04	5.09E-04	1.41E-03
Mandible	2.67E-02	1.98E-03	2.23E-02	6.78E-03	3.61E-02	4.37E-03	8.73E-03	2.92E-03	4.58E-03	1.27E-02
Cervical Vert.	1.00E-03	1.03E-04	8.47E-04	2.93E-04	1.34E-03	2.24E-04	3.78E-04	1.43E-04	2.13E-04	5.08E-04
Thoracic Vert.	3.79E-04	4.19E-05	3.20E-04	1.14E-04	5.03E-04	9.01E-05	1.47E-04	5.69E-05	8.40E-05	1.94E-04
Lumbar Vert.	4.46E-04	5.31E-05	3.78E-04	1.38E-04	5.90E-04	1.13E-04	1.79E-04	7.10E-05	1.04E-04	2.32E-04
Sternum	2.24E-02	2.83E-03	1.91E-02	7.23E-03	2.93E-02	5.99E-03	9.42E-03	3.76E-03	5.47E-03	1.20E-02
Ribs	2.24E-03	2.83E-04	1.91E-03	7.23E-04	2.93E-03	5.99E-04	9.42E-04	3.76E-04	5.47E-04	1.20E-03
Scapulae	6.06E-03	6.73E-04	5.12E-03	1.82E-03	8.08E-03	1.44E-03	2.36E-03	9.13E-04	1.34E-03	3.11E-03
Clavicles	2.02E-02	2.24E-03	1.71E-02	6.06E-03	2.69E-02	4.81E-03	7.85E-03	3.04E-03	4.48E-03	1.04E-02
Os Coxae	1.44E-03	1.60E-04	1.22E-03	4.33E-04	1.92E-03	3.44E-04	5.61E-04	2.17E-04	3.20E-04	7.40E-04
Sacrum	2.17E-03	2.40E-04	1.83E-03	6.50E-04	2.89E-03	5.15E-04	8.41E-04	3.26E-04	4.80E-04	1.11E-03
Humerii, upper half	3.13E-03	3.76E-04	2.65E-03	9.84E-04	4.15E-03	8.07E-04	1.27E-03	5.05E-04	7.37E-04	1.64E-03
Humerii, lower half	2.88E-03	3.44E-04	2.45E-03	9.07E-04	3.81E-03	7.38E-04	1.17E-03	4.64E-04	6.78E-04	1.52E-03
Radii	3.24E-03	3.87E-04	2.75E-03	1.02E-03	4.29E-03	8.30E-04	1.32E-03	5.22E-04	7.63E-04	1.71E-03
Ulna	2.59E-03	3.09E-04	2.20E-03	8.17E-04	3.43E-03	6.64E-04	1.05E-03	4.18E-04	6.10E-04	1.36E-03
Hands	7.41E-03	8.84E-04	6.29E-03	2.33E-03	9.81E-03	1.90E-03	3.01E-03	1.19E-03	1.74E-03	3.90E-03
Femura, upper half	5.03E-04	6.04E-05	4.27E-04	1.58E-04	6.67E-04	1.30E-04	2.04E-04	8.12E-05	1.19E-04	2.64E-04
Femura, lower half	4.63E-04	5.53E-05	3.93E-04	1.46E-04	6.13E-04	1.19E-04	1.88E-04	7.46E-05	1.09E-04	2.44E-04
Patella	8.65E-03	1.03E-03	7.34E-03	2.72E-03	1.14E-02	2.21E-03	3.52E-03	1.39E-03	2.03E-03	4.55E-03
Tibia	5.19E-04	6.19E-05	4.40E-04	1.63E-04	6.86E-04	1.33E-04	2.11E-04	8.35E-05	1.22E-04	2.73E-04
Fibula	3.99E-03	4.76E-04	3.39E-03	1.26E-03	5.28E-03	1.02E-03	1.62E-03	6.42E-04	9.39E-04	2.10E-03
Feet	3.46E-03	4.13E-04	2.94E-03	1.09E-03	4.58E-03	8.86E-04	1.41E-03	5.57E-04	8.14E-04	1.82E-03

Table G.9: Table of S values (mGy MBq^{-1} s^{-1}) to the TBV for 22 different bone sites for a source located in the TBV.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.88E-03	2.60E-04	1.59E-03	5.83E-04	2.53E-03	5.11E-04	8.22E-04	3.39E-04	4.63E-04	9.82E-04
Mandible	1.85E-02	2.56E-03	1.57E-02	5.74E-03	2.49E-02	5.03E-03	8.09E-03	3.34E-03	4.56E-03	9.67E-03
Cervical Vert.	7.20E-04	1.59E-04	6.22E-04	2.87E-04	9.34E-04	3.01E-04	4.21E-04	1.96E-04	2.52E-04	4.30E-04
Thoracic Vert.	2.60E-04	6.18E-05	2.27E-04	1.10E-04	3.33E-04	1.17E-04	1.62E-04	7.64E-05	9.76E-05	1.62E-04
Lumbar Vert.	3.19E-04	8.24E-05	2.81E-04	1.44E-04	4.02E-04	1.56E-04	2.12E-04	1.02E-04	1.29E-04	2.07E-04
Sternum	2.11E-02	5.84E-03	1.88E-02	1.04E-02	2.56E-02	1.11E-02	1.51E-02	7.25E-03	9.25E-03	1.45E-02
Ribs	1.81E-03	5.01E-04	1.62E-03	8.92E-04	2.20E-03	9.56E-04	1.29E-03	6.23E-04	7.94E-04	1.25E-03
Scapulae	3.77E-03	9.20E-04	3.28E-03	1.59E-03	4.85E-03	1.73E-03	2.37E-03	1.13E-03	1.43E-03	2.34E-03
Clavicles	1.18E-02	2.87E-03	1.03E-02	4.97E-03	1.51E-02	5.40E-03	7.38E-03	3.52E-03	4.47E-03	7.30E-03
Os Coxae	8.51E-04	2.07E-04	7.40E-04	3.59E-04	1.09E-03	3.90E-04	5.33E-04	2.54E-04	3.22E-04	5.27E-04
Sacrum	1.48E-03	3.62E-04	1.29E-03	6.27E-04	1.91E-03	6.81E-04	9.30E-04	4.43E-04	5.62E-04	9.20E-04
Humerii, upper half	1.88E-03	4.99E-04	1.65E-03	8.35E-04	2.40E-03	9.35E-04	1.25E-03	6.07E-04	7.63E-04	1.20E-03
Humerii, lower half	1.93E-03	5.14E-04	1.69E-03	8.78E-04	2.43E-03	9.71E-04	1.30E-03	6.30E-04	7.95E-04	1.25E-03
Radii	2.18E-03	5.83E-04	1.92E-03	9.95E-04	2.76E-03	1.10E-03	1.47E-03	7.14E-04	9.01E-04	1.42E-03
Ulna	1.73E-03	4.62E-04	1.52E-03	7.89E-04	2.19E-03	8.73E-04	1.17E-03	5.66E-04	7.15E-04	1.12E-03
Hands	5.00E-03	1.34E-03	4.39E-03	2.28E-03	6.32E-03	2.52E-03	3.37E-03	1.64E-03	2.07E-03	3.25E-03
Femura, upper half	2.93E-04	7.75E-05	2.56E-04	1.30E-04	3.73E-04	1.45E-04	1.94E-04	9.42E-05	1.18E-04	1.87E-04
Femura, lower half	2.99E-04	7.99E-05	2.63E-04	1.36E-04	3.78E-04	1.51E-04	2.01E-04	9.78E-05	1.24E-04	1.94E-04
Patella	5.46E-03	1.46E-03	4.79E-03	2.49E-03	6.90E-03	2.75E-03	3.67E-03	1.78E-03	2.25E-03	3.54E-03
Tibia	3.46E-04	9.24E-05	3.04E-04	1.58E-04	4.38E-04	1.75E-04	2.33E-04	1.13E-04	1.43E-04	2.25E-04
Fibula	2.59E-03	6.92E-04	2.28E-03	1.18E-03	3.28E-03	1.31E-03	1.74E-03	8.47E-04	1.07E-03	1.68E-03
Feet	2.34E-03	6.24E-04	2.05E-03	1.07E-03	2.96E-03	1.18E-03	1.57E-03	7.65E-04	9.66E-04	1.52E-03

Table G.10: Table of S values (mGy MBq^{-1} s^{-1}) to the TAM for 22 different bone sites for a source located in the TAM.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	3.95E-04	1.02E-04	3.44E-04	1.70E-04	5.09E-04	1.91E-04	2.56E-04	1.24E-04	1.56E-04	2.47E-04
Mandible	3.74E-03	9.67E-04	3.25E-03	1.61E-03	4.82E-03	1.81E-03	2.42E-03	1.18E-03	1.47E-03	2.33E-03
Cervical Vert.	1.62E-03	2.43E-04	1.37E-03	5.25E-04	2.15E-03	4.75E-04	7.43E-04	3.14E-04	4.24E-04	8.65E-04
Thoracic Vert.	4.21E-04	6.01E-05	3.57E-04	1.34E-04	5.61E-04	1.18E-04	1.88E-04	7.82E-05	1.07E-04	2.23E-04
Lumbar Vert.	5.90E-04	8.03E-05	4.99E-04	1.83E-04	7.87E-04	1.59E-04	2.57E-04	1.05E-04	1.45E-04	3.09E-04
Sternum	2.51E-03	3.29E-04	2.12E-03	7.72E-04	3.35E-03	6.53E-04	1.07E-03	4.35E-04	6.02E-04	1.31E-03
Ribs	4.83E-04	6.32E-05	4.09E-04	1.49E-04	6.45E-04	1.26E-04	2.07E-04	8.36E-05	1.16E-04	2.52E-04
Scapulae	2.42E-03	3.43E-04	2.05E-03	7.62E-04	3.24E-03	6.73E-04	1.08E-03	4.46E-04	6.08E-04	1.28E-03
Clavicles	8.45E-03	1.20E-03	7.16E-03	2.66E-03	1.13E-02	2.35E-03	3.75E-03	1.56E-03	2.12E-03	4.45E-03
Os Coxae	3.88E-04	5.49E-05	3.28E-04	1.22E-04	5.18E-04	1.08E-04	1.72E-04	7.14E-05	9.72E-05	2.04E-04
Sacrum	6.86E-04	9.71E-05	5.81E-04	2.16E-04	9.16E-04	1.90E-04	3.04E-04	1.26E-04	1.72E-04	3.61E-04
Humerii, upper half	3.12E-03	4.27E-04	2.64E-03	9.66E-04	4.17E-03	8.41E-04	1.36E-03	5.58E-04	7.65E-04	1.63E-03
Humerii, lower half	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radii	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ulna	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hands	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Femura, upper half	1.07E-03	1.46E-04	9.04E-04	3.31E-04	1.43E-03	2.88E-04	4.65E-04	1.91E-04	2.62E-04	5.58E-04
Femura, lower half	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Patella	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tibia	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fibula	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Feet	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

APPENDIX H
BONE SITE-SPECIFIC RADIONUCLIDE S VALUES IN CORTICAL BONE

Table H.1: Table of S values (mGy MBq^{-1} s^{-1}) to the CBE for 22 different bone sites for a source located in the CHS.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	4.70E-04	8.96E-05	4.24E-04	2.13E-04	5.20E-04	1.99E-04	2.65E-04	1.19E-04	1.68E-04	3.12E-04
Mandible	4.77E-03	9.10E-04	4.31E-03	2.16E-03	5.28E-03	2.02E-03	2.70E-03	1.21E-03	1.71E-03	3.17E-03
Cervical Vert.	2.07E-02	3.94E-03	1.87E-02	9.37E-03	2.29E-02	8.77E-03	1.17E-02	5.23E-03	7.39E-03	1.37E-02
Thoracic Vert.	7.75E-03	1.48E-03	7.00E-03	3.51E-03	8.58E-03	3.29E-03	4.38E-03	1.96E-03	2.77E-03	5.15E-03
Lumbar Vert.	6.20E-03	1.18E-03	5.60E-03	2.81E-03	6.86E-03	2.63E-03	3.50E-03	1.57E-03	2.22E-03	4.12E-03
Sternum	1.55E-02	2.96E-03	1.40E-02	7.03E-03	1.72E-02	6.58E-03	8.76E-03	3.92E-03	5.54E-03	1.03E-02
Ribs	1.24E-03	2.37E-04	1.12E-03	5.62E-04	1.37E-03	5.26E-04	7.01E-04	3.14E-04	4.44E-04	8.24E-04
Scapulae	2.39E-03	4.55E-04	2.15E-03	1.08E-03	2.64E-03	1.01E-03	1.35E-03	6.04E-04	8.53E-04	1.59E-03
Clavicles	7.75E-03	1.48E-03	7.00E-03	3.51E-03	8.58E-03	3.29E-03	4.38E-03	1.96E-03	2.77E-03	5.15E-03
Os Coxae	9.40E-04	1.79E-04	8.48E-04	4.26E-04	1.04E-03	3.99E-04	5.31E-04	2.38E-04	3.36E-04	6.25E-04
Sacrum	4.77E-03	9.10E-04	4.31E-03	2.16E-03	5.28E-03	2.02E-03	2.70E-03	1.21E-03	1.71E-03	3.17E-03
Humerii, upper half	2.68E-03	5.51E-04	2.42E-03	1.22E-03	2.97E-03	1.20E-03	1.55E-03	7.11E-04	9.91E-04	1.79E-03
Humerii, lower half	2.68E-03	5.51E-04	2.42E-03	1.22E-03	2.97E-03	1.20E-03	1.55E-03	7.11E-04	9.91E-04	1.79E-03
Radii	4.43E-03	8.45E-04	4.00E-03	2.01E-03	4.90E-03	1.88E-03	2.50E-03	1.12E-03	1.58E-03	2.94E-03
Ulna	3.65E-03	6.96E-04	3.29E-03	1.65E-03	4.04E-03	1.55E-03	2.06E-03	9.23E-04	1.30E-03	2.42E-03
Hands	3.65E-03	6.96E-04	3.29E-03	1.65E-03	4.04E-03	1.55E-03	2.06E-03	9.23E-04	1.30E-03	2.42E-03
Femura, upper half	1.05E-03	2.12E-04	9.56E-04	4.94E-04	1.16E-03	4.71E-04	6.15E-04	2.79E-04	3.93E-04	7.15E-04
Femura, lower half	1.05E-03	2.12E-04	9.56E-04	4.94E-04	1.16E-03	4.71E-04	6.15E-04	2.79E-04	3.93E-04	7.15E-04
Patella	1.55E-02	2.96E-03	1.40E-02	7.03E-03	1.72E-02	6.58E-03	8.76E-03	3.92E-03	5.54E-03	1.03E-02
Tibia	1.22E-03	2.03E-04	1.10E-03	5.28E-04	1.36E-03	4.61E-04	6.49E-04	2.80E-04	4.03E-04	7.91E-04
Fibula	5.64E-03	1.08E-03	5.09E-03	2.55E-03	6.24E-03	2.39E-03	3.19E-03	1.43E-03	2.02E-03	3.75E-03
Feet	1.32E-03	2.52E-04	1.19E-03	5.98E-04	1.46E-03	5.60E-04	7.46E-04	3.34E-04	4.72E-04	8.77E-04

Table H.2: Table of S values (mGy MBq^{-1} s^{-1}) to the CBV for 22 different bone sites for a source located in the CHS.

Skeletal Region	**^{32}P**	**^{33}P**	**^{89}Sr**	**^{90}Sr**	**^{90}Y**	**^{117m}Sn**	**^{153}Sm**	**^{169}Er**	**^{177}Lu**	**^{186}Re**
Cranium	9.69E-05	2.00E-06	7.71E-05	1.47E-05	1.46E-04	4.93E-06	1.94E-05	4.00E-06	7.91E-06	3.58E-05
Mandible	9.50E-04	1.96E-05	7.57E-04	1.44E-04	1.43E-03	4.84E-05	1.90E-04	3.93E-05	7.76E-05	3.52E-04
Cervical Vert.	3.85E-03	7.93E-05	3.06E-03	5.83E-04	5.79E-03	1.96E-04	7.69E-04	1.59E-04	3.14E-04	1.42E-03
Thoracic Vert.	1.52E-03	3.13E-05	1.21E-03	2.30E-04	2.29E-03	7.74E-05	3.04E-04	6.28E-05	1.24E-04	5.62E-04
Lumbar Vert.	1.33E-03	2.74E-05	1.06E-03	2.01E-04	2.00E-03	6.76E-05	2.65E-04	5.48E-05	1.08E-04	4.91E-04
Sternum	3.07E-03	6.34E-05	2.45E-03	4.66E-04	4.63E-03	1.57E-04	6.15E-04	1.27E-04	2.51E-04	1.14E-03
Ribs	2.56E-04	5.28E-06	2.04E-04	3.88E-05	3.86E-04	1.31E-05	5.12E-05	1.06E-05	2.09E-05	9.48E-05
Scapulae	4.96E-04	1.02E-05	3.95E-04	7.51E-05	7.47E-04	2.53E-05	9.91E-05	2.05E-05	4.05E-05	1.83E-04
Clavicles	1.54E-03	3.17E-05	1.22E-03	2.33E-04	2.32E-03	7.83E-05	3.07E-04	6.35E-05	1.25E-04	5.69E-04
Os Coxae	1.93E-04	3.99E-06	1.54E-04	2.93E-05	2.91E-04	9.85E-06	3.87E-05	7.99E-06	1.58E-05	7.16E-05
Sacrum	1.01E-03	2.09E-05	8.08E-04	1.54E-04	1.53E-03	5.17E-05	2.03E-04	4.19E-05	8.28E-05	3.75E-04
Humerii, upper half	4.56E-04	9.77E-06	3.62E-04	6.84E-05	6.96E-04	2.42E-05	9.01E-05	1.92E-05	3.73E-05	1.66E-04
Humerii, lower half	4.56E-04	9.77E-06	3.62E-04	6.84E-05	6.96E-04	2.42E-05	9.01E-05	1.92E-05	3.73E-05	1.66E-04
Radii	7.22E-04	1.49E-05	5.75E-04	1.09E-04	1.09E-03	3.68E-05	1.44E-04	2.98E-05	5.89E-05	2.67E-04
Ulna	5.73E-04	1.18E-05	4.56E-04	8.68E-05	8.63E-04	2.92E-05	1.15E-04	2.37E-05	4.68E-05	2.12E-04
Hands	5.85E-04	1.21E-05	4.66E-04	8.86E-05	8.81E-04	2.98E-05	1.17E-04	2.42E-05	4.78E-05	2.17E-04
Femura, upper half	2.05E-04	4.50E-06	1.64E-04	3.23E-05	3.05E-04	1.11E-05	4.24E-05	8.96E-06	1.75E-05	7.75E-05
Femura, lower half	2.05E-04	4.50E-06	1.64E-04	3.23E-05	3.05E-04	1.11E-05	4.24E-05	8.96E-06	1.75E-05	7.75E-05
Patella	3.00E-03	6.20E-05	2.39E-03	4.55E-04	4.53E-03	1.53E-04	6.01E-04	1.24E-04	2.45E-04	1.11E-03
Tibia	1.56E-04	2.88E-06	1.24E-04	2.29E-05	2.35E-04	7.11E-06	3.05E-05	5.96E-06	1.21E-05	5.73E-05
Fibula	7.06E-04	1.46E-05	5.62E-04	1.07E-04	1.06E-03	3.60E-05	1.41E-04	2.92E-05	5.76E-05	2.61E-04
Feet	2.72E-04	5.60E-06	2.16E-04	4.11E-05	4.09E-04	1.38E-05	5.43E-05	1.12E-05	2.22E-05	1.01E-04

Table H.3: Table of S values (mGy MBq^{-1} s^{-1}) to the CBE for 22 different bone sites for a source located in the CBE.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	2.67E-04	1.46E-04	2.41E-04	1.56E-04	3.29E-04	2.10E-04	3.38E-04	1.84E-04	1.81E-04	2.11E-04
Mandible	2.71E-03	1.49E-03	2.45E-03	1.58E-03	3.35E-03	2.13E-03	3.43E-03	1.86E-03	1.84E-03	2.14E-03
Cervical Vert.	1.18E-02	6.45E-03	1.06E-02	6.86E-03	1.45E-02	9.22E-03	1.49E-02	8.08E-03	7.97E-03	9.27E-03
Thoracic Vert.	4.41E-03	2.42E-03	3.98E-03	2.57E-03	5.44E-03	3.46E-03	5.58E-03	3.03E-03	2.99E-03	3.48E-03
Lumbar Vert.	3.53E-03	1.93E-03	3.19E-03	2.06E-03	4.35E-03	2.77E-03	4.46E-03	2.42E-03	2.39E-03	2.78E-03
Sternum	8.82E-03	4.83E-03	7.97E-03	5.15E-03	1.09E-02	6.92E-03	1.12E-02	6.06E-03	5.98E-03	6.95E-03
Ribs	7.06E-04	3.87E-04	6.37E-04	4.12E-04	8.70E-04	5.53E-04	8.92E-04	4.85E-04	4.78E-04	5.56E-04
Scapulae	1.36E-03	7.44E-04	1.23E-03	7.92E-04	1.67E-03	1.06E-03	1.72E-03	9.32E-04	9.20E-04	1.07E-03
Clavicles	4.41E-03	2.42E-03	3.98E-03	2.57E-03	5.44E-03	3.46E-03	5.58E-03	3.03E-03	2.99E-03	3.48E-03
Os Coxae	5.35E-04	2.93E-04	4.83E-04	3.12E-04	6.59E-04	4.19E-04	6.76E-04	3.67E-04	3.62E-04	4.21E-04
Sacrum	2.71E-03	1.49E-03	2.45E-03	1.58E-03	3.35E-03	2.13E-03	3.43E-03	1.86E-03	1.84E-03	2.14E-03
Humerii, upper half	1.56E-03	9.14E-04	1.42E-03	9.42E-04	1.93E-03	1.29E-03	2.08E-03	1.14E-03	1.12E-03	1.26E-03
Humerii, lower half	1.56E-03	9.14E-04	1.42E-03	9.42E-04	1.93E-03	1.29E-03	2.08E-03	1.14E-03	1.12E-03	1.26E-03
Radii	2.52E-03	1.38E-03	2.28E-03	1.47E-03	3.11E-03	1.98E-03	3.19E-03	1.73E-03	1.71E-03	1.99E-03
Ulna	2.08E-03	1.14E-03	1.87E-03	1.21E-03	2.56E-03	1.63E-03	2.62E-03	1.43E-03	1.41E-03	1.64E-03
Hands	2.08E-03	1.14E-03	1.87E-03	1.21E-03	2.56E-03	1.63E-03	2.62E-03	1.43E-03	1.41E-03	1.64E-03
Femura, upper half	5.76E-04	3.10E-04	5.20E-04	3.32E-04	7.09E-04	4.43E-04	7.16E-04	3.88E-04	3.84E-04	4.51E-04
Femura, lower half	5.76E-04	3.10E-04	5.20E-04	3.32E-04	7.09E-04	4.43E-04	7.16E-04	3.88E-04	3.84E-04	4.51E-04
Patella	8.82E-03	4.83E-03	7.97E-03	5.15E-03	1.09E-02	6.92E-03	1.12E-02	6.06E-03	5.98E-03	6.95E-03
Tibia	7.06E-04	3.71E-04	6.36E-04	4.05E-04	8.72E-04	5.38E-04	8.64E-04	4.68E-04	4.64E-04	5.50E-04
Fibula	3.21E-03	1.76E-03	2.90E-03	1.87E-03	3.95E-03	2.52E-03	4.06E-03	2.20E-03	2.17E-03	2.53E-03
Feet	7.51E-04	4.11E-04	6.78E-04	4.38E-04	9.25E-04	5.89E-04	9.49E-04	5.16E-04	5.09E-04	5.92E-04

Table H.4: Table of S values (mGy MBq^{-1} s^{-1}) to the CBV for 22 different bone sites for a source located in the CBE.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.30E-04	1.14E-05	1.09E-04	3.42E-05	1.77E-04	2.45E-05	4.47E-05	1.59E-05	2.42E-05	6.26E-05
Mandible	1.27E-03	1.12E-04	1.07E-03	3.36E-04	1.73E-03	2.40E-04	4.38E-04	1.56E-04	2.37E-04	6.14E-04
Cervical Vert.	5.16E-03	4.53E-04	4.31E-03	1.36E-03	7.01E-03	9.73E-04	1.77E-03	6.31E-04	9.61E-04	2.48E-03
Thoracic Vert.	2.04E-03	1.79E-04	1.70E-03	5.37E-04	2.77E-03	3.84E-04	7.01E-04	2.49E-04	3.80E-04	9.81E-04
Lumbar Vert.	1.78E-03	1.56E-04	1.49E-03	4.69E-04	2.42E-03	3.36E-04	6.12E-04	2.18E-04	3.32E-04	8.57E-04
Sternum	4.13E-03	3.62E-04	3.45E-03	1.09E-03	5.60E-03	7.77E-04	1.42E-03	5.05E-04	7.68E-04	1.99E-03
Ribs	3.44E-04	3.02E-05	2.87E-04	9.06E-05	4.67E-04	6.48E-05	1.18E-04	4.21E-05	6.40E-05	1.65E-04
Scapulae	6.65E-04	5.83E-05	5.56E-04	1.75E-04	9.04E-04	1.25E-04	2.29E-04	8.14E-05	1.24E-04	3.20E-04
Clavicles	2.06E-03	1.81E-04	1.72E-03	5.43E-04	2.80E-03	3.89E-04	7.09E-04	2.52E-04	3.84E-04	9.93E-04
Os Coxae	2.60E-04	2.28E-05	2.17E-04	6.84E-05	3.53E-04	4.89E-05	8.92E-05	3.17E-05	4.83E-05	1.25E-04
Sacrum	1.36E-03	1.19E-04	1.14E-03	3.59E-04	1.85E-03	2.57E-04	4.68E-04	1.66E-04	2.53E-04	6.55E-04
Humerii, upper half	6.38E-04	5.72E-05	5.34E-04	1.70E-04	8.67E-04	1.23E-04	2.21E-04	7.93E-05	1.20E-04	3.08E-04
Humerii, lower half	6.38E-04	5.72E-05	5.34E-04	1.70E-04	8.67E-04	1.23E-04	2.21E-04	7.93E-05	1.20E-04	3.08E-04
Radii	9.69E-04	8.50E-05	8.10E-04	2.55E-04	1.32E-03	1.83E-04	3.33E-04	1.18E-04	1.80E-04	4.66E-04
Ulna	7.69E-04	6.74E-05	6.43E-04	2.03E-04	1.04E-03	1.45E-04	2.64E-04	9.40E-05	1.43E-04	3.70E-04
Hands	7.85E-04	6.89E-05	6.56E-04	2.07E-04	1.07E-03	1.48E-04	2.70E-04	9.60E-05	1.46E-04	3.78E-04
Femura, upper half	2.66E-04	2.34E-05	2.22E-04	7.02E-05	3.61E-04	5.04E-05	9.15E-05	3.26E-05	4.97E-05	1.28E-04
Femura, lower half	2.66E-04	2.34E-05	2.22E-04	7.02E-05	3.61E-04	5.04E-05	9.15E-05	3.26E-05	4.97E-05	1.28E-04
Patella	4.03E-03	3.54E-04	3.37E-03	1.06E-03	5.48E-03	7.60E-04	1.39E-03	4.93E-04	7.51E-04	1.94E-03
Tibia	2.08E-04	1.78E-05	1.74E-04	5.43E-05	2.83E-04	3.83E-05	7.08E-05	2.50E-05	3.81E-05	9.97E-05
Fibula	9.47E-04	8.31E-05	7.92E-04	2.50E-04	1.29E-03	1.79E-04	3.26E-04	1.16E-04	1.76E-04	4.56E-04
Feet	3.64E-04	3.20E-05	3.05E-04	9.60E-05	4.95E-04	6.87E-05	1.25E-04	4.46E-05	6.78E-05	1.75E-04

Table H.5: Table of S values (mGy MBq^{-1} s^{-1}) to the CBE for 22 different bone sites for a source located in the CBV.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.66E-04	7.15E-06	1.35E-04	3.13E-05	2.31E-04	1.69E-05	4.03E-05	1.16E-05	1.96E-05	6.71E-05
Mandible	1.68E-03	7.26E-05	1.37E-03	3.18E-04	2.35E-03	1.71E-04	4.09E-04	1.18E-04	1.99E-04	6.81E-04
Cervical Vert.	7.28E-03	3.15E-04	5.94E-03	1.38E-03	1.02E-02	7.42E-04	1.77E-03	5.12E-04	8.60E-04	2.95E-03
Thoracic Vert.	2.73E-03	1.18E-04	2.23E-03	5.17E-04	3.82E-03	2.78E-04	6.64E-04	1.92E-04	3.23E-04	1.11E-03
Lumbar Vert.	2.18E-03	9.44E-05	1.78E-03	4.14E-04	3.06E-03	2.23E-04	5.31E-04	1.54E-04	2.58E-04	8.86E-04
Sternum	5.46E-03	2.36E-04	4.46E-03	1 03E-03	7.64E-03	5.56E-04	1.33E-03	3.84E-04	6.45E-04	2.21E-03
Ribs	4.37E-04	1.89E-05	3.56E-04	8.27E-05	6.11E-04	4.45E-05	1.06E-04	3.07E-05	5.16E-05	1.77E-04
Scapulae	8.40E-04	3.63E-05	6.85E-04	1.59E-04	1.18E-03	8.56E-05	2.04E-04	5.90E-05	9.93E-05	3.41E-04
Clavicles	2.73E-03	1.18E-04	2.23E-03	5.17E-04	3.82E-03	2.78E-04	6.64E-04	1.92E-04	3.23E-04	1.11E-03
Os Coxae	3.31E-04	1.43E-05	2.70E-04	6.27E-05	4.63E-04	3.37E-05	8.05E-05	2.33E-05	3.91E-05	1.34E-04
Sacrum	1.68E-03	7.26E-05	1.37E-03	3.18E-04	2.35E-03	1.71E-04	4.09E-04	1.18E-04	1.99E-04	6.81E-04
Humerii, upper half	9.82E-04	4.51E-05	8.04E-04	1.95E-04	1.37E-03	1.06E-04	2.48E-04	7.33E-05	1.22E-04	4.07E-04
Humerii, lower half	9.82E-04	4.51E-05	8.04E-04	1.95E-04	1.37E-03	1.06E-04	2.48E-04	7.33E-05	1.22E-04	4.07E-04
Radii	1.56E-03	6.74E-05	1.27E-03	2.95E-04	2.18E-03	1.59E-04	3.80E-04	1.10E-04	1.84E-04	6.33E-04
Ulna	1.29E-03	5.55E-05	1.05E-03	2.43E-04	1.80E-03	1.31E-04	3.13E-04	9.03E-05	1.52E-04	5.21E-04
Hands	1.29E-03	5.55E-05	1.05E-03	2.43E-04	1.80E-03	1.31E-04	3.13E-04	9.03E-05	1.52E-04	5.21E-04
Femura, upper half	3.52E-04	1.47E-05	2.87E-04	6.59E-05	4.91E-04	3.48E-05	8.50E-05	2.40E-05	4.08E-05	1.43E-04
Femura, lower half	3.52E-04	1.47E-05	2.87E-04	6.59E-05	4.91E-04	3.48E-05	8.50E-05	2.40E-05	4.08E-05	1.43E-04
Patella	5.46E-03	2.36E-04	4.46E-03	1.03E-03	7.64E-03	5.56E-04	1.33E-03	3.84E-04	6.45E-04	2.21E-03
Tibia	4.38E-04	1.84E-05	3.56E-04	8.02E-05	6.16E-04	4.34E-05	1.03E-04	2.98E-05	5.01E-05	1.74E-04
Fibula	1.99E-03	8.58E-05	1.62E-03	3.76E-04	2.78E-03	2.02E-04	4.83E-04	1.40E-04	2.35E-04	8.05E-04
Feet	4.65E-04	2.01E-05	3.79E-04	8.80E-05	6.50E-04	4.74E-05	1.13E-04	3.27E-05	5.49E-05	1.88E-04

Table H.6: Table of S values (mGy MBq^{-1} s^{-1}) to the CBV for 22 different bone sites for a source located in the CBV.

Skeletal Region	^{32}P	^{33}P	^{89}Sr	^{90}Sr	^{90}Y	^{117m}Sn	^{153}Sm	^{169}Er	^{177}Lu	^{186}Re
Cranium	1.34E-04	1.54E-05	1.13E-04	3.87E-05	1.81E-04	3.09E-05	5.34E-05	2.07E-05	2.93E-05	6.77E-05
Mandible	1.32E-03	1.51E-04	1.11E-03	3.79E-04	1.77E-03	3.03E-04	5.24E-04	2.03E-04	2.87E-04	6.64E-04
Cervical Vert.	5.33E-03	6.11E-04	4.48E-03	1.54E-03	7.17E-03	1.23E-03	2.12E-03	8.23E-04	1.16E-03	2.69E-03
Thoracic Vert.	2.10E-03	2.42E-04	1.77E-03	6.07E-04	2.83E-03	4.85E-04	8.38E-04	3.25E-04	4.59E-04	1.06E-03
Lumbar Vert.	1.84E-03	2.11E-04	1.55E-03	5.30E-04	2.47E-03	4.24E-04	7.32E-04	2.84E-04	4.01E-04	9.28E-04
Sternum	4.26E-03	4.89E-04	3.58E-03	1.23E-03	5.73E-03	9.81E-04	1.69E-03	6.58E-04	9.29E-04	2.15E-03
Ribs	3.55E-04	4.07E-05	2.99E-04	1.02E-04	4.77E-04	8.18E-05	1.41E-04	5.48E-05	7.74E-05	1.79E-04
Scapulae	6.86E-04	7.88E-05	5.78E-04	1.98E-04	9.24E-04	1.58E-04	2.73E-04	1.06E-04	1.50E-04	3.47E-04
Clavicles	2.13E-03	2.44E-04	1.79E-03	6.14E-04	2.86E-03	4.91E-04	8.47E-04	3.29E-04	4.65E-04	1.07E-03
Os Coxae	2.68E-04	3.07E-05	2.25E-04	7.72E-05	3.60E-04	6.17E-05	1.07E-04	4.14E-05	5.85E-05	1.35E-04
Sacrum	1.40E-03	1.61E-04	1.18E-03	4.05E-04	1.89E-03	3.24E-04	5.59E-04	2.17E-04	3.07E-04	7.09E-04
Humerii, upper half	6.57E-04	7.51E-05	5.53E-04	1.89E-04	8.84E-04	1.51E-04	2.61E-04	1.01E-04	1.43E-04	3.31E-04
Humerii, lower half	6.57E-04	7.51E-05	5.53E-04	1.89E-04	8.84E-04	1.51E-04	2.61E-04	1.01E-04	1.43E-04	3.31E-04
Radii	9.99E-04	1.15E-04	8.41E-04	2.88E-04	1.35E-03	2.30E-04	3.98E-04	1.54E-04	2.18E-04	5.05E-04
Ulna	7.93E-04	9.11E-05	6.68E-04	2.29E-04	1.07E-03	1.83E-04	3.16E-04	1.23E-04	1.73E-04	4.01E-04
Hands	8.10E-04	9.30E-05	6.82E-04	2.34E-04	1.09E-03	1.87E-04	3.23E-04	1.25E-04	1.77E-04	4.09E-04
Femura, upper half	2.74E-04	3.14E-05	2.31E-04	7.89E-05	3.69E-04	6.31E-05	1.09E-04	4.23E-05	5.97E-05	1.38E-04
Femura, lower half	2.74E-04	3.14E-05	2.31E-04	7.89E-05	3.69E-04	6.31E-05	1.09E-04	4.23E-05	5.97E-05	1.38E-04
Patella	4.16E-03	4.78E-04	3.50E-03	1.20E-03	5.60E-03	9.59E-04	1.66E-03	6.43E-04	9.08E-04	2.10E-03
Tibia	2.16E-04	2.49E-05	1.82E-04	6.25E-05	2.90E-04	5.00E-05	8.62E-05	3.35E-05	4.73E-05	1.09E-04
Fibula	9.77E-04	1.12E-04	8.23E-04	2.82E-04	1.32E-03	2.25E-04	3.89E-04	1.51E-04	2.13E-04	4.94E-04
Feet	3.76E-04	4.32E-05	3.16E-04	1.08E-04	5.06E-04	8.67E-05	1.50E-04	5.81E-05	8.21E-05	1.90E-04

APPENDIX I
PROGRAM USED TO GENERATE VOXEL S VALUES FOR ANY RADIONUCLIDE AND ANY VOXEL SIZE

```
/*******************************************************************/
/*      LIONEL G. BOUCHET                                          */
/*      09/15/98                                                   */
/*      PROGRAM TO TABULATE S VALUE IN A VOXEL ARRANGEMENT FOR     */
/*      ANY RADIONUCLIDE, AND ANY VOXEL SIZE BETWEEN 0.05 cm and   */
/*      1.00 cm.                                                   */
/*      THE INPUT PARAMETERS FOR THE PROGRAM ARE THE VOXEL SIZE,   */
/*      THE RADIONUCLIDE, AND THE MAXIMAL DISTANCE AT WHICH THE    */
/*      S VALUES HAVE TO BE TABULATED.                             */
/*      THE OUTPUT OF THE PROGRAM ARE 2 FILES:                     */
/*            S_value_IJK_0.30-cm_p-32.dat                         */
/*            S_value_DIST_0.30-cm_p-32.dat                        */
/*******************************************************************/
#include <stdio.h>
#include <string.h>
#include <string.h>
#include <math.h>

#define NUMB_VOXEL_SIZE          20
#define MAX_ENERGY               12
#define NUMB_CUBE                3
#define MAX_DIST_FILE            727
#define MAX_NUMB_DIST            30000
#define DIST_                    600
#define BREM_CUT_OFF             0.100

double  SAF_dist_p[NUMB_CUBE][MAX_DIST_FILE][MAX_ENERGY]={0.};
double  SAF_dist_e[NUMB_CUBE][MAX_DIST_FILE][MAX_ENERGY]={0.};
double  dist[NUMB_CUBE][MAX_DIST_FILE];
double  SAF_PK_p[DIST_PK][MAX_ENERGY]={0.0},
        SAF_PK_e[DIST_PK][MAX_ENERGY]={0.0},
        dist_Sphere[DIST_PK];
double  S_val[MAX_NUMB_DIST]={0.};
double  Final_Dist[MAX_NUMB_DIST]={0.};
double  NRG[MAX_ENERGY]=  {0.010,0.015,0.020,
                          0.030,0.050,0.100,
                          0.200,0.500,1.000,
                          1.500,2.000,4.000};
double ListCube[NUMB_VOXEL_SIZE]={0.05,0.10,0.15,
                                 0.20,0.25,0.30,
                                 0.35,0.40,0.45,
                                 0.50,0.55,0.60,
                                 0.65,0.70,0.75,
                                 0.80,0.85,0.90,
                                 0.95,1.00};
double cube0,
       cube1,
       cube2;
double MaxDist;
int    MatrixSize;
int     MaxNumbDist;
int     ChangeIndP,
        ChangeIndE[MAX_ENERGY];
double  range[MAX_ENERGY];
char    radionuclide[30];

main(int argc, char *argv[])
{
        void  initialization(void);
        void  read_saf(double cube, int Ind_Cube);
        void  read_saf_PK(void);
        void  Calculate_Svalues(void);
        void  interpolate_saf(void);
        void  Print_Svalues(void);

        initialization();
        if (cube0==cube1) {
              read_saf(cube0,0);
        }
        else {
              read_saf(cube1,1);
              read_saf(cube2,2);
              interpolate_saf();
        }
        read_saf_PK();
        Calculate_Svalues();
        Print_Svalues();

}/*END MAIN PROGRAM*/


void    initialization(void)
{
        int         i,
                    j,
                    Int_Test;
        int         tmpCube,
                    tmpDist,
                    Choice;
        FILE        *ifp;

        void  get_list_distance(void);

        printf("Enter voxel size (cm) for S value ( >0.05 cm and < 1.0 cm) :
\n");
        Int_Test=scanf("%lf",&cube0);
        if (Int_Test==0 ||
            cube0 < ListCube[0] ||
            cube0 > ListCube[NUMB_VOXEL_SIZE-1]) {
              printf("Enter a distance (cm) between 0.05 cm and 1 cm \n");
              printf("Try Again....\n");
              exit(0);
        }

        printf("Enter Name of the radionuclide file: \n");
        scanf("%s",radionuclide);

        printf("Want 1) Maximal Distance or 2) Max Number of Voxel ? \n");
        scanf("%d",&Choice);
        if (Choice==1) {
              printf("Enter Max distance (cm) for S value file (< 60 cm):\n");
              scanf("%lf",&MaxDist);
              MatrixSize=(int)(MaxDist/(sqrt(3)*cube0)+1.)+ 1;
        }
        else if (Choice==2) {
              printf("Enter Max Number of Voxel (excluding source):\n");
              scanf("%d",&MatrixSize);
              MatrixSize=MatrixSize+1; /*Because we use it in the program*/
              MaxDist=cube0*sqrt(3)*(MatrixSize-1);
        }
        else {
              printf("Wrong Input \n Try Again ... \n");
              exit(0);
        }

        get_list_distance();
        i=0;
        while (!(cube0 >= ListCube[i] && cube0 < ListCube[i+1])) {
              i=i+1;
        }
        cube1=ListCube[i];
        cube2=ListCube[i+1];

/* Rcsda Ranges for e- in cm*/
        range[0]=2.e-4;     /* 10keV*/
        range[1]=5.e-4;     /* 15keV*/
        range[2]=8.e-4;     /* 20keV*/
        range[3]=1.7e-3;    /* 30keV*/
        range[4]=4.2e-3;    /* 50keV*/
        range[5]=1.38e-2;   /* 100keV*/
        range[6]=4.31e-2;   /* 200keV*/
        range[7]=1.7e-1;    /* 500keV*/
        range[8]=4.2e-1;    /* 1000keV*/
        range[9]=6.8e-1;    /* 1500keV*/
        range[10]=9.41e-1;  /* 2000keV*/
        range[11]=1.96;     /* 4000keV*/

        ChangeIndP=22;
        for (i=0;i<MAX_ENERGY;i++) {
              if (NRG[i] >= BREM_CUT_OFF) {
                     j=0;
                     tmpCube=(int)(cube0*100.);
                     do {
                            j=j+1;
                            tmpDist=(int)(Final_Dist[j]*100.);
                     } while (((Final_Dist[j]*100-tmpDist)!=0 ||
                     tmpDist%tmpCube != 0 ||
                     range[i] > (Final_Dist[j]-cube0))  &&
                     (j < MAX_DIST_FILE));
                     ChangeIndE[i]=j;
              }
        }
} /* END SUBROUTINE initialization*/

void    Print_Svalues(void)
{
        double       tmpDist;
        int          i,
                     j,
                     k,
                     h;
        char         outputfile[100];
        FILE         *ofp;

        sprintf(outputfile,"S_value_DIST_%.2f-cm_%s",cube0,radionuclide);
        ofp=fopen(outputfile,"w");
        printf("Output in File: %s \n",outputfile);
        fprintf(ofp,"Total Number of Distance: \n %d\n",MaxNumbDist);
        for (i=0;i<MaxNumbDist;i++)
              fprintf(ofp,"%.5f %.4e\n",Final_Dist[i],S_val[i]);
        fclose(ofp);

        sprintf(outputfile,"S_value_IJK_%.2f-cm_%s",cube0,radionuclide);
        ofp=fopen(outputfile,"w");
```

```
       printf("Output in File: %s \n",outputfile);
       fprintf(ofp,"Number of Voxel in One Direction: \n %d\n",MatrixSize);
       for (i=0;i<MatrixSize;i++)
             for (j=0;j<MatrixSize;j++)
                    for (k=0;k<MatrixSize;k++) (
                           tmpDist=cube0*sqrt((double)(i*i+j*j+k*k));
                           h=0;
                           while (fabs(tmpDist-Final_Dist[h]) > 1.e-8) {
                                 h=h+1;
                           }
                           fprintf(ofp,"%d %d %d %.4e\n",i,j,k,S_val[h]);
                    }
       fclose(ofp);
} /* END SUBROUTINE Print_Svalues*/
```

```
void read_saf(double cube,int Ind_Cube)
(
       int          i,
                    Ind_NRG;
       Double       tmpf;
       Char         inputfile[100],
                    junk_str[155];
       FILE  *ifp1,
             *ifp2;

       sprintf(inputfile,"../SAF/CHANGE/photons/RESULTS_%.2fcm.dat",cube);
       ifp1=fopen(inputfile,"r");
       printf("Reading Photons File: %s \n",inputfile);
       if (ifp1 ==0) (
             printf("error opening file %s \n",inputfile);
             exit(0);
       }
       sprintf(inputfile,"../SAF/CHANGE/electrons/RESULTS_%.2fcm.dat",cube);
       ifp2=fopen(inputfile,"r");
       printf("Reading Electrons File: %s \n",inputfile);
       if (ifp2 ==0) (
             printf("error opening file %s \n",inputfile);
             exit(0);
       }
       for (i=0;i<4;i++) {
             fgets(junk_str,155,ifp1);
             fgets(junk_str,155,ifp2);
       }
       for (Ind_NRG=0;Ind_NRG<MAX_ENERGY;Ind_NRG++) {
             fscanf(ifp1,"%lf\n",&tmpf);
             fscanf(ifp2,"%lf\n",&tmpf);
             for (i=0;i<MAX_DIST_FILE;i++) (
                    if (fscanf(ifp1,"%lf %lf \n",&dist[Ind_Cube][i],
                           &SAF_dist_p[Ind_Cube][i][Ind_NRG])!=2) {
                    printf("Error reading Photon File\n");
                    exit(0);
             }
                    if (fscanf(ifp2,"%lf %lf \n",&tmpf,
                           &SAF_dist_e[Ind_Cube][i][Ind_NRG])!=2) {
                           printf("Error reading Electron File \n");
                           exit(0);
                    }
             }
       }
       fclose(ifp1);
       fclose(ifp2);
}/* END SUBROUTINE read_saf*/
```

```
void read_saf_PK(void)
(
       int          i,
                    Ind_NRG;
```

```
        double          tmpf;
        char            inputfile[100],
                        junk_str[155];
        FILE            *ifp1,
                        *ifp2;

        sprintf(inputfile,"../SAF/RAW/PointKernelSAF_photons.dat");
        ifp1=fopen(inputfile,"r");
        printf("Reading PK File: %s \n",inputfile);
        if (ifp1 ==0) (
                printf("error opening file %s \n",inputfile);
                exit(0);
        )
        sprintf(inputfile,"../SAF/RAW/PointKernelSAF_electrons.dat");
        ifp2=fopen(inputfile,"r");
        printf("Reading PK File: %s \n",inputfile);
        if (ifp2 ==0) (
                printf("error opening file %s \n",inputfile);
                exit(0);
        )
        for (i=0;i<4;i++) (
                fgets(junk_str,155,ifp1);
                fgets(junk_str,155,ifp2);
        )
/*READ FIRST THE 12 ENERGIES OF THE PHOTONS*/
        for (Ind_NRG=0;Ind_NRG<12;Ind_NRG++) (
                fscanf(ifp1,"%lf\n",&tmpf);
                for (i=0;i<DIST_PK;i++) (
                        if (fscanf(ifp1,"%lf %lf %lf \n",&dist_Sphere[i],
                                &SAF_PK_p[i][Ind_NRG],&tmpf)!=3) (
                                printf("Error reading\n");
                                printf("Input file Photon\n");
                                exit(0);
                        )
                )
        )
/*READ THE 7 ENERGIES OF THE ELECTRONS*/
        for (Ind_NRG=5;Ind_NRG<12;Ind_NRG++) (
                fscanf(ifp2,"%lf\n",&tmpf);
                for (i=0;i<DIST_PK;i++) (
                        if (fscanf(ifp2,"%lf %lf %lf \n",&dist_Sphere[i],
                                &SAF_PK_e[i][Ind_NRG],&tmpf)!=3) (
                                printf("Error reading\n");
                                printf("Input file: %s \n",inputfile);
                                exit(0);
                        )
                )
        )
        fclose(ifp1);
        fclose(ifp2);
)/* END SUBROUTINE read_safPK*/

void interpolate_saf(void)
(
        int             i,
                        j,
                        Ind_NRG;
        Double          A1,
                        A2,
                        SAF,
                        SAF0,
                        SAF1,
                        AF,
                        volume;
        int             tmpInt;

/* START WITH PHOTONS*/
```

```
/*Source cube: a simple linear interpollation between 2 voxel sizes is done */
        for (Ind_NRG=0;Ind_NRG<MAX_ENERGY;Ind_NRG++) {
              volume=cube1*cube1*cube1;
              A1=SAF_dist_p[1][0][Ind_NRG]*volume;
              volume=cube2*cube2*cube2;
              A2=SAF_dist_p[2][0][Ind_NRG]*volume;
              volume=cube0*cube0*cube0;
              AF=(A2-A1)*(cube0-cube2)/(cube2-cube1)+A2;
              SAF_dist_p[0][0][Ind_NRG]=AF/volume;
        }

        for (i=1;i<ChangeIndP;i++) {
              for (Ind_NRG=0;Ind_NRG<3;Ind_NRG++) {
                     A1=SAF_dist_p[1][i][Ind_NRG]*dist[1][i]*dist[1][i];
                     A2=SAF_dist_p[2][i][Ind_NRG]*dist[2][i]*dist[2][i];
                     SAF=(log10(A2)-log10(A1))*(cube0-cube2)/(cube2-
cube1)+log10(A2);
                     SAF=pow(10,SAF);
                     SAF_dist_p[0][i][Ind_NRG]=SAF/dist[0][i]/dist[0][i];
              }
              for (Ind_NRG=3;Ind_NRG<MAX_ENERGY;Ind_NRG++) {
                     A1=SAF_dist_p[1][i][Ind_NRG]*dist[1][i]*dist[1][i];
                     A2=SAF_dist_p[2][i][Ind_NRG]*dist[2][i]*dist[2][i];
                     SAF=(A2-A1)*(cube0-cube2)/(cube2-cube1)+A2;
                     SAF_dist_p[0][i][Ind_NRG]=SAF/dist[0][i]/dist[0][i];
              }
        }

/*THEN WE DO THE SAME FOR ELECTRONS */
        for (Ind_NRG=0;Ind_NRG<MAX_ENERGY;Ind_NRG++) {
/* For the source point: Do only interpolation  of AF*/
              volume=cube1*cube1*cube1;
              A1=SAF_dist_e[1][0][Ind_NRG]*volume;
              volume=cube2*cube2*cube2;
              A2=SAF_dist_e[2][0][Ind_NRG]*volume;
              AF=(log10(A2)-log10(A1))*(cube0-cube2)/(cube2-cube1)+log10(A2);
              AF=pow(10,AF);
              volume=cube0*cube0*cube0;
              SAF_dist_e[0][0][Ind_NRG]=AF/volume;
              if (NRG[Ind_NRG] < BREM_CUT_OFF)
                     tmpInt=MAX_DIST_FILE;
              else
                     tmpInt=ChangeIndE[Ind_NRG];
              for (i=1;i<tmpInt;i++) {
                     volume=cube1*cube1*cube1;
                     A1=SAF_dist_e[1][i][Ind_NRG]*volume;
                     volume=cube2*cube2*cube2;
                     A2=SAF_dist_e[2][i][Ind_NRG]*volume;
/* DO SEMI LOG INTERPOLATION BETWEEN CUBE SIZES */
                     if (A1 != 0.0 && A2 != 0.0)  {
                            AF=(log10(A2)-log10(A1))*(cube0-cube2)/
                               (cube2-cube1)+log10(A2);
                            AF=pow(10,AF);
                     }
                     else if (A1 == 0.0 && A2 !=0.0)
                            AF=A1;
                     else if (A2!=0.0)
                            AF=A2;
                     else
                            AF=0.0;
                     volume=cube0*cube0*cube0;
                     SAF_dist_e[0][i][Ind_NRG]=AF/volume;
              }
        }
}/* END SUBROUTINE interpolate_saf*/

void Calculate_Svalues(void)
```

```
{
        int     i,
                    j,
                    Ind_NRG,
                    Ind_Cube,
                    numb_transi,
                    tmpi;
        double      tmpf,
                    coef,
                    abund,
                    energy[300],
                    delta[300],
                    saf;
        char        inputfile[100],
                    junk_str[155],
                    decay[300][10];
        FILE        *ifp;

        double      get_saf_phot(int i,double energy);
        double      get_saf_elec(int i,double energy);

/*  S=delta(g-rad/mic.C-h) * SAF(g-1) * (1h/3600s) *                */
/*    (1Gy/100rad) * (1000mGy/1Gy) * (1mic.C/3.7e4Bq) *             */
/*    (1e6Bq/MBq)= delta * SAF * 7.5075e-2 = S (mGy/MBq/s)          */
        coef=7.5075e-2;
        printf(" ********* S VALUES TABULATED IN mGy/MBq-s *********\n");
        sprintf(inputfile,"/disk1/egs4/MIRD/MIRD2/%s",radionuclide);
        printf("Reading Radionuclide File: %s \n",inputfile);
        ifp=fopen(inputfile,"r");
        if (ifp ==0) {
              printf("error opening file %s \n",inputfile);
              exit(0);
        }
        for (j=1;j<=5;++j)
              fgets(junk_str,155,ifp);
        if (fscanf(ifp,"%d %lf",&numb_transi,&tmpf)!=2)
              printf("error reading Radionuclide %s\n",radionuclide);
        for (j=0;j<numb_transi;j++)
              if (fscanf(ifp,"%s %d %lf %lf %lf ",
                  decay[j],&tmpi,&tmpf,&energy[j],&delta[j])!=5)
                    printf("error reading Radionuclide %s \n",inputfile);
        fclose(ifp);
        for (i=0;i<MaxNumbDist;i++) {
              for (j=0;j<numb_transi;j++) {
                    if (strcmp("GAMMA",decay[j])==0 ||
                        strcmp("KXALPH",decay[j])==0)
                           saf=get_saf_phot(i,energy[j]);
                    else if (strcmp("KLLAUG",decay[j])==0 ||
                             strcmp("KCONV",decay[j])==0  ||
                             strcmp("BETA",decay[j])==0)
                           saf=get_saf_elec(i,energy[j]);
                    else {
                           printf("Unknown Decay %s in radionuclide file %s\n",
                           decay[j],radionuclide);
                           exit(0);
                    }
                    S_val[i]=S_val[i]+saf*delta[j]*coef;
              }
        }
}/* END Calculate_Svalues */

double  get_saf_phot(int i,double energy)
{
        double      saf,
                    A1,
                    A2,
                    SAF0,
                    SAF1;
       int          k=0,
                    j=0;

       do {
             k=k+1;
       } while (NRG[k] < energy &&
                k != MAX_ENERGY-1) ;
       if (i < ChangeIndP) {
             SAF0=SAF_dist_p[0][i][k-1];
             SAF1=SAF_dist_p[0][i][k];
       }
       else {
/* INTERPOLATE THE DISTANCE USING THE PK DATA */
             do {
                    j=j+1;
             } while (dist_Sphere[j] < Final_Dist[i]);
             A1=SAF_PK_p[j-1][k-1]*dist_Sphere[j-1]*dist_Sphere[j-1];
             A2=SAF_PK_p[j][k-1]*dist_Sphere[j]*dist_Sphere[j];
             SAF0=(A2-A1)*(Final_Dist[i]-dist_Sphere[j])/
             (dist_Sphere[j]-dist_Sphere[j-1])+A2;
             SAF0=SAF0/Final_Dist[i]/Final_Dist[i];
             A1=SAF_PK_p[j-1][k]*dist_Sphere[j-1]*dist_Sphere[j-1];
             A2=SAF_PK_p[j][k]*dist_Sphere[j]*dist_Sphere[j];
             SAF1=(A2-A1)*(Final_Dist[i]-dist_Sphere[j])/
               (dist_Sphere[j]-dist_Sphere[j-1])+A2;
             SAF1=SAF1/Final_Dist[i]/Final_Dist[i];
       }
       saf=(SAF1-SAF0)*(energy-NRG[k-1])/(NRG[k]-NRG[k-1])+SAF0;
       if (k!=1)
             saf=(SAF1-SAF0)*(log10(energy)-log10(NRG[k-1]))/
                (log10(NRG[k])-log10(NRG[k-1]))+SAF0;
       if (saf < 0.0 ) {
             if (k==1 && i != 0) {
                    SAF1=SAF_dist_p[0][i][0];
                    saf=(SAF1-0.0)*(energy-NRG[0])/NRG[0]+SAF1;
             }
             else {
                    printf("Error interpo phot %d %d %g %f\n",k,i,saf,energy);
                    printf("Error interpo phot2 %g %g \n",SAF0,SAF1);
             }
       }
       return(saf);
}/* END SUBROUTINE get_saf_phot*/

double  get_saf_elec(int i,double energy)
{
       double       saf,
                    A1,
                    A2,
                    SAF0,
                    SAF1;
       int          k=0,
                    j=0;

       do {
             k=k+1;
       } while (NRG[k] < energy &&
                k != MAX_ENERGY-1) ;
       if (energy < BREM_CUT_OFF ||   /*NO BREMSSTRAHLUNG BELOW BREM_CUT_OFF*/
           (i==0)              ||   /* SOURCE CUBE */
           (i < ChangeIndE[k-1] && i < ChangeIndE[k])) {
             SAF0=SAF_dist_e[0][i][k-1];
             SAF1=SAF_dist_e[0][i][k];
       }
       else if ((i < ChangeIndE[k-1] && i >= ChangeIndE[k])) {
/* INTERPOLATE ONLY THE HIGHEST ENERGY */
```

```
             SAF0=SAF_dist_e[0][i][k-1];
             do {
                    j=j+1;
             } while (dist_Sphere[j] < Final_Dist[i]);
             A1=SAF_PK_e[j-1][k]*dist_Sphere[j-1]*dist_Sphere[j-1];
             A2=SAF_PK_e[j][k]*dist_Sphere[j]*dist_Sphere[j];
             SAF1=(A2-A1)*(Final_Dist[i]-dist_Sphere[j])/
                 (dist_Sphere[j]-dist_Sphere[j-1])+A2;
             SAF1=SAF1/Final_Dist[i]/Final_Dist[i];
        }
        else {
/* INTERPOLATE THE DISTANCE USING THE PK DATA */
             do {
                    j=j+1;
             } while (dist_Sphere[j] < Final_Dist[i]);
             A1=SAF_PK_e[j-1][k-1]*dist_Sphere[j-1]*dist_Sphere[j-1];
             A2=SAF_PK_e[j][k-1]*dist_Sphere[j]*dist_Sphere[j];
             SAF0=(A2-A1)*(Final_Dist[i]-dist_Sphere[j])/
                (dist_Sphere[j]-dist_Sphere[j-1])+A2;
             SAF0=SAF0/Final_Dist[i]/Final_Dist[i];
             A1=SAF_PK_e[j-1][k]*dist_Sphere[j-1]*dist_Sphere[j-1];
             A2=SAF_PK_e[j][k]*dist_Sphere[j]*dist_Sphere[j];
             SAF1=(A2-A1)*(Final_Dist[i]-dist_Sphere[j])/
                (dist_Sphere[j]-dist_Sphere[j-1])+A2;
             SAF1=SAF1/Final_Dist[i]/Final_Dist[i];
        }
        saf=(SAF1-SAF0)*(energy-NRG[k-1])/(NRG[k]-NRG[k-1])+SAF0;
        if (k!=1)
             saf=(SAF1-SAF0)*(log10(energy)-log10(NRG[k-1]))/
                (log10(NRG[k])-log10(NRG[k-1]))+SAF0;
        if (saf < 0.0 ) {
             if (k==1 && i != 0) {
                    SAF1=SAF_dist_e[0][i][0];
                    saf=(SAF1-0.0)*(energy-NRG[0])/(0.-NRG[0])+SAF1;
             }
             else {
                    printf("Error interpo elec %d %d %g %f\n",k,i,saf,energy);
                    printf("Error interpo elec2 %g %g \n",SAF0,SAF1);
             }
        }
        return(saf);
}/* END SUBROUTINE get_saf_elec*/

void  get_list_distance(void)
{
        double       saf,
                     A1,
                     A2;
        int          i,
                     j,
                     k;
        for (i=0;i<MatrixSize;i++)
             for (j=0;j<MatrixSize;j++)
             for (k=0;k<MatrixSize;k++)
                    Final_Dist[i*i+j*j+k*k]=cube0*sqrt((double)(i*i+j*j+k*k));
        k=1;
        for (i=1;i<3*MatrixSize*MatrixSize;i++)
             if (Final_Dist[i]!=0) {
                    Final_Dist[k]=Final_Dist[i];
                    k=k+1;
             }
        MaxNumbDist=k;  /* from 0 to MaxNumbDist-1 */
}/* END SUBROUTINE get_list_distance*/
```

APPENDIX J
OUTPUTS OF THE PROGRAM TO GENERATE VOXEL S VALUES

a) SCREEN CAPTURE OF THE OUTPUT OF THE VOXEL S VALUE PROGRAM (bolded text represents input from the user)

```
Enter voxel size (cm) for S value ( >0.05 cm and < 1.0 cm) :
0.53
Enter Name of the radionuclide file:
i-131.dat
Want 1) Maximal Distance or 2) Max Number of Voxel ?
2
Enter Max Number of Voxel (excluding source):
20
Reading Photons File: ../SAF/CHANGE/photons/RESULTS_0.50cm.dat
Reading Electrons File: ../SAF/CHANGE/electrons/RESULTS_0.50cm.dat
Reading Photons File: ../SAF/CHANGE/photons/RESULTS_0.55cm.dat
Reading Electrons File: ../SAF/CHANGE/electrons/RESULTS_0.55cm.dat
Reading PK File: ../SAF/RAW/PointKernelSAF_photons.dat
Reading PK File: ../SAF/RAW/PointKernelSAF_electrons.dat
 ********* S VALUES TABULATED IN mGy/MBq-s *********
Reading Radionuclide File: /disk1/egs4/MIRD/MIRD2/i-131.dat
Output in File: S_value_DIST_0.53-cm_i-131.dat
Output in File: S_value_IJK_0.53-cm_i-131.dat
```

b) LISTING OF THE OUTPUT FILE: S_value_DIST_0.53-cm_i-131.dat

```
Total Number of Distance:
727

0.00000   1.8524e-01   4.79935   6.9147e-06   6.82857   3.3696e-06   8.38004   2.1903e-06
0.53000   4.4527e-03   4.82853   6.8286e-06   6.86959   3.3312e-06   8.39678   2.1795e-06
0.74953   4.5693e-04   4.85753   6.7475e-06   6.89000   3.3113e-06   8.43017   2.1582e-06
0.91799   2.0740e-04   4.88636   6.6768e-06   6.91035   3.2916e-06   8.44681   2.1477e-06
1.06000   1.4509e-04   4.91502   6.6078e-06   6.93065   3.2722e-06   8.48000   2.1337e-06
1.18512   1.1692e-04   4.97184   6.4640e-06   6.95088   3.2529e-06   8.49655   2.1272e-06
1.29823   9.7032e-05   5.00001   6.3866e-06   6.97106   3.2318e-06   8.51306   2.1207e-06
1.49907   7.1879e-05   5.02802   6.3109e-06   6.99118   3.2109e-06   8.52954   2.1142e-06
1.59000   6.3895e-05   5.05588   6.2365e-06   7.03124   3.1698e-06   8.54599   2.1078e-06
1.67601   5.7260e-05   5.11113   6.0898e-06   7.05119   3.1496e-06   8.56241   2.0973e-06
1.75781   5.1993e-05   5.13854   6.0188e-06   7.07108   3.1287e-06   8.57880   2.0856e-06
1.83597   4.7125e-05   5.19292   5.8902e-06   7.09092   3.1081e-06   8.61148   2.0623e-06
1.91094   4.3792e-05   5.21989   5.8290e-06   7.11070   3.0877e-06   8.62777   2.0508e-06
1.98308   4.0998e-05   5.24673   5.7691e-06   7.13042   3.0675e-06   8.64404   2.0394e-06
2.12000   3.6334e-05   5.27343   5.7107e-06   7.15009   3.0477e-06   8.66027   2.0307e-06
2.18525   3.3412e-05   5.30000   5.6534e-06   7.18927   3.0194e-06   8.67647   2.0234e-06
2.24860   3.1879e-05   5.32643   5.5972e-06   7.20878   3.0055e-06   8.69265   2.0162e-06
2.31022   2.9599e-05   5.35274   5.5416e-06   7.22824   2.9917e-06   8.70879   2.0090e-06
2.37023   2.8121e-05   5.40496   5.4235e-06   7.24764   2.9781e-06   8.74098   1.9948e-06
2.42877   2.7427e-05   5.43088   5.3661e-06   7.28630   2.9462e-06   8.75704   1.9878e-06
2.48592   2.5845e-05   5.45668   5.3123e-06   7.30555   2.9304e-06   8.77306   1.9808e-06
2.59646   2.3505e-05   5.48236   5.2666e-06   7.34390   2.8991e-06   8.78906   1.9738e-06
2.65000   2.2741e-05   5.50792   5.2216e-06   7.36300   2.8834e-06   8.80502   1.9669e-06
2.70248   2.1891e-05   5.53336   5.1775e-06   7.38205   2.8676e-06   8.82096   1.9600e-06
2.75396   2.1102e-05   5.55869   5.1328e-06   7.40105   2.8521e-06   8.83687   1.9532e-06
2.85414   1.9666e-05   5.63398   4.9968e-06   7.42000   2.8366e-06   8.86860   1.9398e-06
2.90293   1.9004e-05   5.65885   4.9539e-06   7.43890   2.8214e-06   8.88442   1.9332e-06
2.99813   1.7823e-05   5.68362   4.9133e-06   7.45776   2.8059e-06   8.90021   1.9266e-06
3.04462   1.7296e-05   5.70827   4.8734e-06   7.49533   2.7745e-06   8.91598   1.9201e-06
3.09040   1.6773e-05   5.73283   4.8342e-06   7.51405   2.7591e-06   8.94743   1.9071e-06
3.13552   1.6276e-05   5.75727   4.7946e-06   7.53272   2.7438e-06   8.96311   1.8994e-06
3.18000   1.5808e-05   5.80586   4.7125e-06   7.55134   2.7288e-06   8.99440   1.8837e-06
3.22386   1.5365e-05   5.83000   4.6725e-06   7.56991   2.7162e-06   9.01000   1.8759e-06
3.26714   1.4957e-05   5.85404   4.6331e-06   7.58845   2.7037e-06   9.02557   1.8682e-06
3.35201   1.4235e-05   5.87798   4.5945e-06   7.60693   2.6913e-06   9.04112   1.8605e-06
3.39366   1.3869e-05   5.92558   4.5190e-06   7.64377   2.6669e-06   9.05664   1.8528e-06
3.43479   1.3520e-05   5.94924   4.4822e-06   7.66212   2.6522e-06   9.07214   1.8452e-06
3.47544   1.3212e-05   5.99627   4.4003e-06   7.68043   2.6362e-06   9.08761   1.8376e-06
3.51562   1.2930e-05   6.01964   4.3602e-06   7.69869   2.6204e-06   9.11846   1.8227e-06
3.55535   1.2658e-05   6.04293   4.3208e-06   7.71692   2.6048e-06   9.13385   1.8152e-06
3.59463   1.2378e-05   6.06613   4.2865e-06   7.73510   2.5893e-06   9.14922   1.8079e-06
3.67195   1.1863e-05   6.08924   4.2546e-06   7.75323   2.5744e-06   9.16456   1.8018e-06
3.71000   1.1636e-05   6.11226   4.2232e-06   7.78938   2.5497e-06   9.17987   1.7958e-06
3.74767   1.1417e-05   6.13519   4.1922e-06   7.80739   2.5375e-06   9.19516   1.7898e-06
3.78496   1.1179e-05   6.18081   4.1306e-06   7.82536   2.5254e-06   9.21042   1.7839e-06
3.82188   1.0949e-05   6.20349   4.1002e-06   7.84328   2.5134e-06   9.24087   1.7721e-06
3.85846   1.0737e-05   6.22609   4.0702e-06   7.87902   2.4918e-06   9.25605   1.7659e-06
3.89469   1.0562e-05   6.24861   4.0406e-06   7.89682   2.4813e-06   9.27121   1.7590e-06
3.96616   1.0214e-05   6.27104   4.0104e-06   7.93231   2.4607e-06   9.28635   1.7521e-06
4.00141   1.0023e-05   6.29340   3.9805e-06   7.95000   2.4505e-06   9.30146   1.7453e-06
4.03636   9.8392e-06   6.31568   3.9510e-06   7.96765   2.4378e-06   9.31655   1.7385e-06
4.07101   9.6681e-06   6.36000   3.8939e-06   7.98526   2.4252e-06   9.33161   1.7318e-06
4.13943   9.3512e-06   6.38205   3.8668e-06   8.00282   2.4126e-06   9.36167   1.7195e-06
4.17322   9.1941e-06   6.40401   3.8400e-06   8.02036   2.4002e-06   9.37666   1.7142e-06
4.24000   8.8891e-06   6.42591   3.8136e-06   8.03785   2.3879e-06   9.39162   1.7089e-06
4.27300   8.7533e-06   6.44773   3.7876e-06   8.07272   2.3660e-06   9.40657   1.7037e-06
4.30574   8.6256e-06   6.46947   3.7618e-06   8.09010   2.3558e-06   9.43638   1.6933e-06
4.33824   8.5018e-06   6.49115   3.7364e-06   8.10744   2.3457e-06   9.45125   1.6881e-06
4.37049   8.3785e-06   6.53428   3.6864e-06   8.12475   2.3357e-06   9.48093   1.6766e-06
4.40251   8.2572e-06   6.55574   3.6613e-06   8.14201   2.3258e-06   9.49573   1.6709e-06
4.43430   8.1392e-06   6.57713   3.6349e-06   8.15925   2.3158e-06   9.51051   1.6652e-06
4.49720   7.9048e-06   6.59845   3.6088e-06   8.17644   2.3058e-06   9.52527   1.6596e-06
4.52832   7.7910e-06   6.64088   3.5577e-06   8.22781   2.2764e-06   9.54000   1.6540e-06
4.55923   7.6839e-06   6.66200   3.5339e-06   8.24487   2.2668e-06   9.55471   1.6483e-06
4.58993   7.5876e-06   6.70403   3.4893e-06   8.26188   2.2574e-06   9.56940   1.6423e-06
4.62043   7.4938e-06   6.72495   3.4674e-06   8.27886   2.2481e-06   9.59871   1.6304e-06
4.65073   7.4020e-06   6.74580   3.4457e-06   8.29581   2.2389e-06   9.61333   1.6245e-06
4.68083   7.2972e-06   6.76659   3.4260e-06   8.31273   2.2297e-06   9.62793   1.6186e-06
4.74046   7.0957e-06   6.78731   3.4070e-06   8.34645   2.2117e-06   9.64250   1.6128e-06
4.77000   7.0031e-06   6.80797   3.3882e-06   8.36326   2.2011e-06   9.65706   1.6075e-06
```

9.67159	1.6026e-06	10.92623	1.2238e-06	12.05095	9.7812e-07	13.10076	8.0366e-07
9.68610	1.5978e-06	10.93908	1.2201e-06	12.06260	9.7530e-07	13.11148	8.0234e-07
9.71506	1.5883e-06	10.95191	1.2164e-06	12.08586	9.6967e-07	13.12218	8.0103e-07
9.72951	1.5836e-06	10.96473	1.2133e-06	12.09747	9.6688e-07	13.13288	7.9972e-07
9.74393	1.5789e-06	10.97753	1.2101e-06	12.10908	9.6410e-07	13.15425	7.9703e-07
9.75833	1.5740e-06	10.99031	1.2070e-06	12.12067	9.6133e-07	13.16493	7.9555e-07
9.77272	1.5690e-06	11.01584	1.2008e-06	12.13225	9.5857e-07	13.17559	7.9407e-07
9.78708	1.5641e-06	11.02859	1.1978e-06	12.14383	9.5582e-07	13.18625	7.9259e-07
9.80142	1.5591e-06	11.04131	1.1947e-06	12.15539	9.5370e-07	13.19689	7.9112e-07
9.83004	1.5493e-06	11.05403	1.1915e-06	12.17847	9.5086e-07	13.20753	7.8966e-07
9.84431	1.5445e-06	11.06672	1.1878e-06	12.19000	9.4944e-07	13.21816	7.8820e-07
9.85857	1.5393e-06	11.07941	1.1842e-06	12.20152	9.4803e-07	13.25000	7.8385e-07
9.87281	1.5339e-06	11.09208	1.1806e-06	12.21302	9.4663e-07	13.26060	7.8211e-07
9.90122	1.5232e-06	11.11737	1.1734e-06	12.22452	9.4523e-07	13.27118	7.8038e-07
9.91539	1.5180e-06	11.13000	1.1699e-06	12.23600	9.4384e-07	13.29233	7.7694e-07
9.94368	1.5075e-06	11.14261	1.1663e-06	12.24747	9.4245e-07	13.30289	7.7522e-07
9.95780	1.5027e-06	11.15521	1.1631e-06	12.27039	9.3878e-07	13.32399	7.7182e-07
9.97189	1.4983e-06	11.18036	1.1573e-06	12.28183	9.3689e-07	13.33453	7.7012e-07
9.98597	1.4939e-06	11.19292	1.1545e-06	12.29326	9.3502e-07	13.34506	7.6843e-07
10.00002	1.4896e-06	11.23050	1.1460e-06	12.30468	9.3315e-07	13.35558	7.6695e-07
10.01406	1.4852e-06	11.24300	1.1432e-06	12.32749	9.2944e-07	13.37660	7.6435e-07
10.02807	1.4809e-06	11.25548	1.1406e-06	12.33887	9.2759e-07	13.38709	7.6306e-07
10.05604	1.4724e-06	11.26795	1.1384e-06	12.36162	9.2371e-07	13.41853	7.5922e-07
10.07000	1.4682e-06	11.28041	1.1362e-06	12.37297	9.2169e-07	13.42899	7.5794e-07
10.08394	1.4641e-06	11.29286	1.1340e-06	12.38432	9.1967e-07	13.44989	7.5541e-07
10.09786	1.4600e-06	11.31770	1.1297e-06	12.40698	9.1566e-07	13.46033	7.5387e-07
10.11176	1.4559e-06	11.33011	1.1275e-06	12.41830	9.1367e-07	13.47076	7.5233e-07
10.12564	1.4518e-06	11.34250	1.1254e-06	12.42960	9.1168e-07	13.49160	7.4928e-07
10.13950	1.4477e-06	11.35487	1.1230e-06	12.45218	9.0773e-07	13.50200	7.4776e-07
10.18097	1.4361e-06	11.36723	1.1203e-06	12.46345	9.0573e-07	13.51240	7.4624e-07
10.19475	1.4323e-06	11.37958	1.1177e-06	12.47472	9.0374e-07	13.52279	7.4473e-07
10.20852	1.4286e-06	11.39192	1.1150e-06	12.48597	9.0176e-07	13.53317	7.4322e-07
10.22227	1.4248e-06	11.41655	1.1097e-06	12.49722	8.9978e-07	13.54355	7.4172e-07
10.23600	1.4211e-06	11.42885	1.1071e-06	12.50845	8.9781e-07	13.55391	7.4015e-07
10.24971	1.4174e-06	11.44113	1.1045e-06	12.51967	8.9585e-07	13.57462	7.3676e-07
10.27708	1.4070e-06	11.45340	1.1018e-06	12.54209	8.9195e-07	13.58497	7.3507e-07
10.29074	1.4018e-06	11.46565	1.0989e-06	12.55328	8.8997e-07	13.59530	7.3339e-07
10.30438	1.3966e-06	11.47790	1.0960e-06	12.56447	8.8789e-07	13.60563	7.3171e-07
10.31800	1.3915e-06	11.49013	1.0932e-06	12.57564	8.8582e-07	13.61595	7.3004e-07
10.34519	1.3813e-06	11.51455	1.0875e-06	12.58680	8.8375e-07	13.62626	7.2838e-07
10.35875	1.3774e-06	11.52674	1.0847e-06	12.59796	8.8170e-07	13.63656	7.2672e-07
10.38584	1.3710e-06	11.53892	1.0818e-06	12.60910	8.7965e-07	13.65714	7.2394e-07
10.39935	1.3678e-06	11.55108	1.0791e-06	12.63136	8.7557e-07	13.66742	7.2305e-07
10.41285	1.3646e-06	11.57537	1.0735e-06	12.64247	8.7354e-07	13.67770	7.2216e-07
10.42633	1.3615e-06	11.58750	1.0707e-06	12.65358	8.7171e-07	13.68796	7.2127e-07
10.43979	1.3584e-06	11.61172	1.0652e-06	12.66467	8.7026e-07	13.70847	7.1950e-07
10.45323	1.3549e-06	11.62381	1.0625e-06	12.68683	8.6738e-07	13.71871	7.1862e-07
10.46666	1.3505e-06	11.63588	1.0598e-06	12.69790	8.6595e-07	13.73917	7.1687e-07
10.49346	1.3417e-06	11.64795	1.0571e-06	12.72000	8.6309e-07	13.74939	7.1600e-07
10.50684	1.3374e-06	11.66000	1.0546e-06	12.73104	8.6168e-07	13.75960	7.1458e-07
10.52020	1.3331e-06	11.67204	1.0521e-06	12.74206	8.6026e-07	13.76980	7.1312e-07
10.53354	1.3287e-06	11.68407	1.0496e-06	12.75308	8.5871e-07	13.79019	7.1022e-07
10.54687	1.3245e-06	11.70808	1.0447e-06	12.76409	8.5680e-07	13.80037	7.0878e-07
10.56018	1.3209e-06	11.72007	1.0423e-06	12.77509	8.5489e-07	13.82071	7.0591e-07
10.57347	1.3175e-06	11.73205	1.0398e-06	12.78608	8.5299e-07	13.83087	7.0448e-07
10.60000	1.3108e-06	11.74402	1.0374e-06	12.80803	8.4920e-07	13.85116	7.0167e-07
10.61324	1.3075e-06	11.75597	1.0351e-06	12.81899	8.4732e-07	13.86130	7.0054e-07
10.62647	1.3042e-06	11.76791	1.0329e-06	12.82994	8.4545e-07	13.87143	6.9942e-07
10.63968	1.3009e-06	11.77984	1.0307e-06	12.84088	8.4358e-07	13.88155	6.9830e-07
10.65287	1.2977e-06	11.81555	1.0240e-06	12.85182	8.4174e-07	13.90177	6.9606e-07
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c) LISTING OF THE OUTPUT FILE: S_value_IJK_0.53-cm_i-131.dat

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19	20	2	6.10E-07
19	20	3	6.05E-07
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BIOGRAPHICAL SKETCH

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Wesley E. Bolch

Wesley E. Bolch, Chairman
Associate Professor of Nuclear and
Radiological Engineering

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

David E. Hintenlang
Associate Professor of Nuclear and
Radiological Engineering

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Samim Anghaie

Samim Anghaie
Professor of Nuclear and
Radiological Engineering

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Jatinder R Palta

Jatinder R. Palta
Professor of Nuclear and
Radiological Engineering

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Walter E Drane

Walter E. Drane
Professor of Radiology

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Christiana M Leonard

Christiana M. Leonard
Professor of Neuroscience

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December, 1998

Winfred M. Phillips
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